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A DESTRUCTIVE VIRUS DISEASE OF PANGOLA-GRASS[1]

Met een samenvatting: Een virusziekte van Pangola-gras

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INTRODUCTION

Pangola-grass *(Digitaria decumbens* STENT.) grows very well under Surinam conditions. As it is at the same time a very good pasture-grass (APPELMAN & DIRVEN, 1959), some hundreds of acres have been planted since its introduction in 1951. Due to the fact that extensive plantings in Florida, the Caribbean Islands and Central- and South-America have all originated from the vegetative propagation of 3 to 5 plants imported into Florida in 1940, there is danger, according to WHYTE (1959), that the lack of hereditary variation will increase the incidence of diseases and pests.

Since its introduction to Surinam, pangola-grass has been troubled by serious attacks of army-worms *(Laphygma frugiperda* A. & S. and *Mocis repanda* F.) and slugs *(Homalonyx unguis* D'ORB.). These pests may at times seriously depress yields, but can be controlled with Aldrin and HCH respectively. The fungus *Mycosphaerella tassiana* (DE NOT.) JOH.[4] is often present, especially on the older leaves.[5] The losses caused by this fungus can be limited by rotational grazing. Since the extremely dry years of 1957 and 1958 chinch bugs *(Blissus leucopterus* SAY) and Rhodes grass scales *(Antonina graminis* MASKELL) have also been serious pests (VAN DOESBURG, 1959). During the rainy season, however, these insects decrease drastically in number.

During the last three years a dying-off of the grass has been noticed for which no direct cause was detectable. This paper describes the symptoms of this disease and also experiments which show that the disease is due to a virus, transmitted by a delphacid vector.

DESCRIPTION OF THE DISEASE

The presence of stunt disease in pangola-grass pastures is first indicated by slower recovery of affected plants following mowing or grazing. The vigour of growth is greatly reduced and other grasses and leafy weeds establish themselves on the affected areas. This is very abnormal for the aggressive pangola. On well drained clay soils pangola is replaced by *Cynodon dactylon* (L.) PERS., *Sporobo-*

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[5] The shape of the leaf spots is very irregular; they are grey coloured, elongated parallel to the midrib and measure up to 1 cm. They are red zoned. The perithecia are mostly situated under the upper epidermis. The spores measure 20 × 3,6 μ. We also observed the fungus on pangola when visiting Cuba in August 1959.

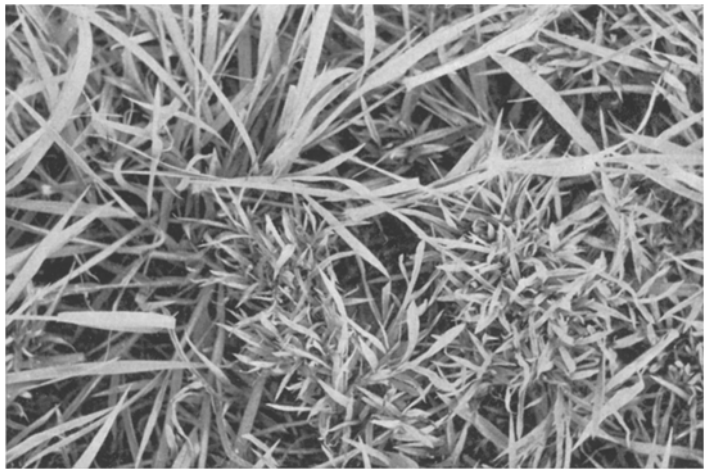

FIG. 1. Field symptoms of the disease. At left: healthy plant with long stolone, overgrowing a diseased patch.
Veldsymptomen van de ziekte. Links een gezonde plant met lange uitloper, die een zieke plek overgroeit.

FIG. 2. Detail of diseased shoot, showing deformations of the leaves, youngest leaf rolled and twisted (outmost left) and abnormal branching.
Detail van een zieke stengel met misvormde bladeren en abnormale vertakking, terwijl het jongste blad (uiterst links) opgerold en gedraaid is.

FIG. 3. Severely diseased pangola-plant, four months after the insects were placed on it. At right: Healthy control.
Ernstig zieke pangola-plant, vier maanden nadat er insekten op geplaatst waren. Rechts: gezonde controle-plant.

lus indicus (L.) R.BR. and *Sp. poiretti* (ROEM & SCHULT.) HITCHC., on sandy soils of the young coastal plain by *Axonopus compressus* (SW.) BEAUV. and *Alternanthera sessilis* (L.) R.BR. and on the loamy sand soils of the old coastal plain by *Panicum laxum* SW. Although pangola is rather drought-resistant, patches of dead grass appear in the fields, especially in the dry season. Among the diseased plants which cease to form long runners, one can frequently observe well-grown plants with long runners. Diseased plants are easily torn off at soil-level by grazing animals. The disease spreads only slowly.

Even a moderate degree of infection may result in a lower yield than that of native grasses on the same type of soil. The yield can be depressed by 50% or more.

The first effect of the disease becomes evident in diminished growth. The length of the internodes, which in healthy plants may reach more than 6 cm, is rarely more than 1 cm in diseased plants. The following table, which compares the sizes of 100 internodes from diseased and healthy plants 4 weeks old, illustrates this difference clearly.

TABLE 1. Length of 100 internodes of healthy and diseased pangola-grass.
Lengte van 100 internodiën van gezond en ziek pangola-gras.

Length class in cm *Lengteklasse in cm*	Frequency *Frequentie*	
	Healthy *Gezond*	Diseased *Ziek*
0–1	5	61
1–2	19	37
2–3	27	2
3–4	21	
4–5	13	
5–6	10	
6 and more	5	

As a direct consequence of the shortening of the internodes, coupled with abnormal and repeated branching, the plant acquires a tufted appearance (fig. 1). The leaves are very short and irregular in shape. The youngest leaf, which is at first rolled up, emerges curved; even after unfolding it remains warped and the tip is more or less obtuse. The colour of the leaves, which in healthy plants is green (5 GY 4/4–4/6, according to MUNSELL Soil Color Charts) is changed into dark yellowish (5 GY 6/6–6/8), while quite frequently parts of the leaves appear yellow-green to yellow and the tips of the leaves weak red (7,5 R 5/4). These phenomena are not caused by a deficiency disease, as the symptoms appear simultaneously on different soil types, the disease does not disappear after fertilization with macro or micro elements, and growth may be healthy again after plowing. Furthermore, when diseased root and stem cuttings are propagated in good soil, they produce only diseased plants. The above mentioned symptoms, therefore, led us to suspect a virus disease. It is well-known that virus diseases transmitted by Jassids and Delphacids may cause stunted growth. For that reason we determined which species of these insects occurred on pangola.

INSECTS ON PANGOLA-GRASS

The insects caught in 20 sweeps of approximately 1 meter with a catching net with an opening of 50 cm × 20 cm have been identified.[1] That a very great number of Jassids can be found on pangola-grass is evident from table 2.

TABLE 2. Jassids and Delphacids caught with an insect net on pangola.
Jassiden en Delphaciden, die in 20 slagen met een insektenet op pangola-gras gevangen werden.

	Paramaribo		Lelydorp (25 km South of Paramaribo)
	1–7–59	10–2–60	28–9–59
Jassids			
Hortensia similis WALKER	685	20	535
Carneocephala sagittifera UHLER .	286	11	133
Plesiommata mollicella FOWLER . .	85	57	584
Graminella cognita CALDWELL . .	344	66	544
Stirellus picinus BERG	36	5	1
Deltocephalus flavicosta STAL. . . .	4	–	1
Deltocephalus marginellus METC. . .	6	–	–
Protalebrella brasiliensis BAKER . .	–	–	1
Draeculacephala clypeata OSBORN .	117	–	1
Delphacids (only males could be identified)			
Sogata furcifera HORVATH	7	8	5
Sogata cubana CRAWFORD	3	–	–

With 20 sweeps one catches insects on an area of approximately 10 m^2. Should one calculate the number of insects per ha, it would certainly reach millions, especially since the numbers in the above table relate to adults only. On 30 farms where we caught insects, other Jassids and Delphacids than those mentioned were sometimes present. *Sogata furcifera*, however, was never absent, although it varied considerably in number. The number of males of this species caught in 20 sweeps varied between 1 and 39.

Taking into account that this insect was found on all pangola pastures it was decided to test it first in transmission experiments. It was felt also that the relatively small numbers of this species as compared with some others made it perhaps a more likely vector, bearing in mind the relatively slow spread of the disease.

EXPERIMENTAL TRANSMISSION OF THE DISEASE

Healthy planting material and virus-free *Sogata furcifera* were obtained from a small isolated plot on which no symptoms of the disease could be observed. At the conclusion of the experiments the grass on this plot remained healthy. Stem cuttings from diseased plants in other fields were used as a virus source. These cuttings rooted rapidly under plastic, while the symptom picture remained unchanged. Virus-free *Sogata furcifera* were placed upon diseased

[1] Identified by J. P. KRAMER, U.S. Dept. of Agr., Agr. Res. Service, Entom. Res. Div., BELTSVILLE, Maryland.

plants for 3 to 10 days under cover and were afterwards transferred to healthy cuttings. In other tests *Sogata furcifera* which had been raised on diseased plants were used. The insects always remained on the test plants for several weeks. As controls, stem cuttings from healthy plants were used on which virus-free *Sogata furcifera* were fed. No virus symptoms were ever observed on this control group. This proves that the insects we considered virus-free were indeed non-infective. For results of these experiments see table 3.

TABLE 3. Transmission of pangola-grass stunt virus by *Sogata furcifera*.
Overbrenging van het virus van pangola-gras door Sogata furcifera.

Number of insects used *Aantal gebruikte insekten*	Period on virus source *Duur van verblijf op virusbron*	Number of diseased plants *Aantal zieke planten*	Number of plants tested *Aantal getoetste planten*
many/*vele*	3 days/*3 dagen*	8	8
many/*vele*	0 days/*0 dagen*	0	6
15	bred on diseased plants *op zieke planten gekweekt*	2	7
12	bred on diseased plants *op zieke planten gekweekt*	6	7
20	0 days/*0 dagen*	0	9
15	10 days/*10 dagen*	8	8

A considerable time elapsed before the first symptoms of the disease were observed. Only after two months did the youngest leaves begin to be lighter in colour. Later the youngest, not yet unfurled leaf, started to curl and remained irregular in shape even after its elongation. Further development of the disease symptoms was also very slow; the internodes gradually became shorter and many axillary shoots started to develop (figs. 2 and 3). The symptoms described were more conspicious on new growth following mowing than on older uncut growth.

CULTIVATION PRACTICES

Since some vigorously growing healthy plants always occurred among the diseased plants in a pasture, an effort was made to see whether or not affected pastures could be renovated by plowing. After plowing the healthy plants multiply rapidly, while the diseased plants have no strength left for further growth. It was found that in cases of moderately diseased pastures a fine stand could be obtained in this way as indicated by the yield determination of experimental 50 m² plots (table 4).

TABLE 4. Yield of moderately diseased pangola pasture, three months after plowing.
Opbrengst van een matig zieke pangola-weide, drie maanden nadat ze geploegd werd.

	Fresh grass in kg/ha *Vers gras in kg/ha*	Percentage dry matter *Percentage droge stof*	Dry matter in kg/ha *Droge stof in kg/ha*
Field 1/*Veld 1*	22,000	17.8	3,952
Field 2/*Veld 2*	21,600	19.5	4,214

The yields shown in the table are again excellent ones. Nevertheless after the first cutting productivity declines, the development of runners is slow and the symptoms of the disease can be noticed again all over the field. It is only because of the rapid growth of the healthy grass plants and the prolonged incubation period of the virus that it is possible to obtain temporarily productive grasslands, once the disease has appeared. In seriously diseased pastures, on the other hand, the recovery rate was alwyas too slow to make plowing worth while.

Because of this disease the distribution of planting material of pangola-grass has been discontinued for the time. Attempts are being made to obtain new oecotypes of pangola, which may possibly be resistant to the disease.

Of the two forms of *Digitaria pentzii*, No. S.R. 908 and No. S.R. 924, imported from Trinidad (I.C.T.A.), No. 924 proved to be susceptible to the virus, whereas No. 908 has until now remained free from symptoms. Furthermore we shall proceed to distribute planting material of *Brachiaria brizantha* (HOECHST) STAPF. and *B. decumbens* STAPF. which appear to be resistant to the virus.

CONCLUSIONS

As the symptoms of this disease have been observed on plots separated by considerable distances and as we also found healthy plots, it seems highly probable that in Surinam the virus has hosts among the natural vegetation. That the disease has been spread only by the distribution of diseased planting material seems less probable, as the disease does not appear to be more acute on fields where the planting material originated, than on others. In view of the serious nature of this disease, especially during the dry season, it can be expected that the damage in areas with rainfall below the Surinam average of 2285 mm per year (at Parmaribo) will be more severe than in the higher rainfall areas.

SUMMARY

In Surinam a destructive stunt virus disease has appeared in pangola-grass during the last three years. The symptoms are described and also experiments proving that the delphacid *Sogata furcifera* HORVATH is a vector of the disease. It seems possible that the virus may be present in symptomless wild grasses, because even in isolated fields the disease often starts after a period of healthy growth. The best control for this disease is the planting of other grasses resistant to the virus.

SAMENVATTING

De laatste jaren treedt in Suriname op pangola-gras een slechte groei en een sterfte op, waarvoor geen directe oorzaak viel aan te wijzen. In een weide bemerkt men eerst, dat de nieuwe groei van het gras na afmaaien of afgrazen zeer traag verloopt. De groeikracht is zo sterk afgenomen, dat andere grassen en onkruiden dit normaliter agressieve gras verdringen. Gedurende de droge tijd ontstaan dode plekken in het weiland, hoewel pangola-gras tamelijk droogte-

resistent is. Tussen deze dode planten worden vaak nog gezonde, goed groeiende planten met lange uitlopers waargenomen. De slechte plekken in het weiland breiden zich langzaam uit.

De opbrengst van een matig aangetast weiland daalt met 50 procent of meer. Bij de zieke planten valt allereerst de geringe lengtegroei op. De internodiën – bij een gezond gras meestal meerdere cm lang – worden korter dan 1 cm (tabel 1). De planten zijn bovendien abnormaal vertakt, waardoor een bossig uiterlijk ontstaat (fig. 1). De bladlengte neemt af en de bladvorm wordt onregelmatig en gaat krommingen vertonen (fig. 2 en 3). De symptomen doen aan een virusziekte denken. Bemesting met sporenelementen gaf geen verbetering.

Uit de volgende proeven bleek, dat de ziekte inderdaad door een virus wordt veroorzaakt. Op weilanden met zieke pangola werden insekten gevangen (tabel 2). Omdat wij een keuze uit de verschillende soorten moesten maken, en *Sogata furcifera* in alle vangsten aanwezig was, werd besloten overbrengingsproeven met dit insekt uit te voeren. Gezond plantmateriaal werd verzameld op een plaats, waar het gras geen afwijkingen vertoonde. Ook na afloop van onze proeven kwam de ziekte daar nog niet voor. Op dit veld werd ook *Sogata furcifera* gevangen, die, op gezonde planten geplaatst, geen afwijkingen veroorzaakte. Werden ze echter eerst op zieke pangola-planten gezet en daarna op gezonde, dan werden de laatste na verloop van enige tijd ziek (tabel 3); de eerste ziektesymptomen traden pas na twee maanden op. Zijn de planten al oud en heeft in de pot niet veel lengtegroei meer plaats, dan ontstaat het ziektebeeld pas na afsnijden op de jonge uitlopers.

Ploegen van matig aangetaste graslanden geeft een zeer goede eerste snede (tabel 4); het uitlopen hierna geschiedt echter traag en de ziekte blijkt weer op te treden.

Van twee uit Trinidad geïmporteerde vormen van *Digitaria pentzii* bleef er één tot nu toe vrij van de ziekte. Voordat echter een voor de praktijk bruikbare resistente *Digitaria* gevonden zal zijn, wordt overgegaan tot vervroegde uitgifte van enige veelbelovende, voor dit virus onvatbare grassen. Aangezien het virus gevonden werd op ver uit elkaar gelegen percelen die aanvankelijk gezond waren, lijkt het waarschijnlijk, dat in Suriname waardplanten tussen de inheemse grassoorten voorkomen.

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