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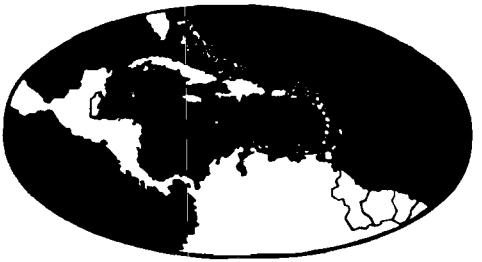

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THE DISTRIBUTION PATTERN OF INTERNAL BROWN SPOT DISEASE IN *DIOSCOREA ALATA* L. CV. WHITE LISBON

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SUMMARY

Studies on the longitudinal and lateral distributions of Internal Brown Spot disease (IBS) in tubers of *Dioscorea alata* cv. White Lisbon showed that most IBS lesions were found in the middle regions of tubers (longitudinal) and that lesions were more frequently observed in the periphery than in the centre of tubers (lateral). There was no apparent association of lesion size with position in tubers. By means of a tracing technique, it was observed that lesions could be localised towards one side of a tuber although in most cases lesions were found randomly dispersed in the periphery of tuber slices. The distribution pattern of IBS in whole plants was variable. Approximately 74% of plants sampled during the 1974/75 season had both IBS-free and IBS-infected tubers per plant while the remainder had either all IBS-free tubers (ca 11%) or all IBS-infected tubers per plant (ca 15%). The implications of these observations in relation to IBS assessment and current work are discussed.

INTRODUCTION

Internal Brown Spot (IBS) of yam (*Dioscorea* spp.) has been reported to occur on several cultivars of *Dioscorea alata*, including *D. alata* cv. White Lisbon, and to be widespread in the Commonwealth Caribbean (Jeffers and Headley, 1967; Mantell *et al.*, 1974). At present, there is still uncertainty as to the casual agent(s) of this disease although available evidence, both of an indirect and direct nature (Mantell *et al.*, 1974), suggests that a virus (or possibly several viruses) is associated with this disease.

Apart from some observations and surveys made in the late 1960's, there has been little work carried out to establish the distribution pattern of IBS in the field and in infected tubers. A survey of *D. alata* cv. White Lisbon crops in Barbados by Jeffers and Headley (1967), however, did establish that where IBS occurred in a field the disease did not appear to be localised, that IBS was present in tubers grown on all Barbados soil types and that some plantations were apparently free of IBS. It has also been recorded that IBS lesions most commonly occur near the 'head' end of tubers (Coursey, 1967).

Information on the distribution of IBS in tubers and in individual plants may be useful in determining the feasibility of selection

methods in obtaining disease-free planting material. Therefore, the purpose of this paper is to describe some features of the distribution of IBS based on data obtained from studies of the development of IBS in storage and in the field.

MATERIALS AND METHODS

A batch of 300 tubers of *D. alata* cv. White Lisbon which was selected at random from a crop grown at Craignish, Princess Town, Trinidad in the 1973/74 season was sampled to determine the distribution of IBS in tubers. IBS incidence was assessed using a slicing technique (Mantell *et al.*, 1974) with a modification i.e. slices were cut at right angles to the maximum vertical distance (MVD); see Fig. 1. The longitudinal and lateral distribution of IBS lesions was determined by slicing from the tail to the head end using the following methods:-

(1) Longitudinal distribution

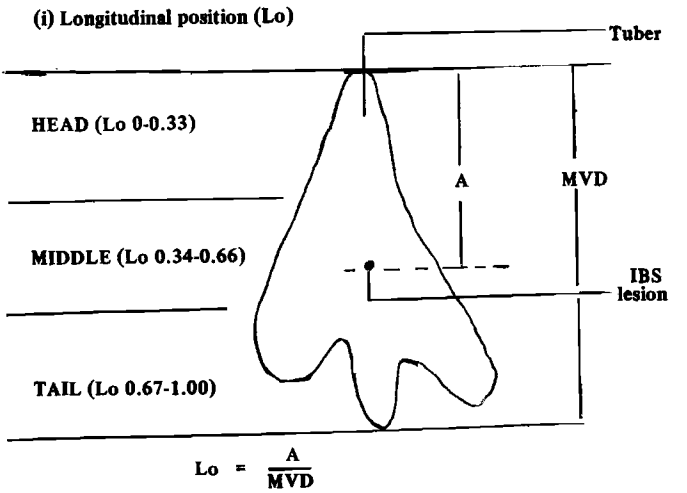
The MVD of each tuber was recorded before slicing and the distance (A) of each slice from the head noted when a lesion was observed. In this way the longitudinal position (Lo) was represented by the ration A: MVD (see Fig. 1, i).

(2) Lateral distribution

During slicing the maximum diameter (MD) and the distance of lesions from the edge (B), of each affected tuber slice was recorded and the lateral position (La) represented by the ratio B: ½ MD (see Fig 1, ii).

An attempt to relate the longitudinal and lateral positions of lesions was made using a tracing paper technique. Before slicing, tubers were pierced along the MVD axis with a large knitting needle and the surface of each tuber scored with a knife along a similar axis. In this way slices were associated with each other by the reference marks made by the knife and the needle. The position of IBS lesions in relation to the outline of the slice and the reference marks was traced on coarse tracing paper and then mapped on plain white paper. By this method a picture was constructed of the distribution of lesions in a single tuber.

Information on the distribution of IBS in the field was obtained from field experiments carried out during the 1974/75 season. In Barbados, data were collected from experiments planted at Graeme Hall (Christ Church), Dodds Hall (St. Philip) and Thicket (St. Philip) and in Trinidad, from three field trials planted at the University of the West Indies Field Station. IBS incidence on each plant was determined by slicing harvested tubers in situ in the field. In this way mixing of tuber material from different plants was avoided.



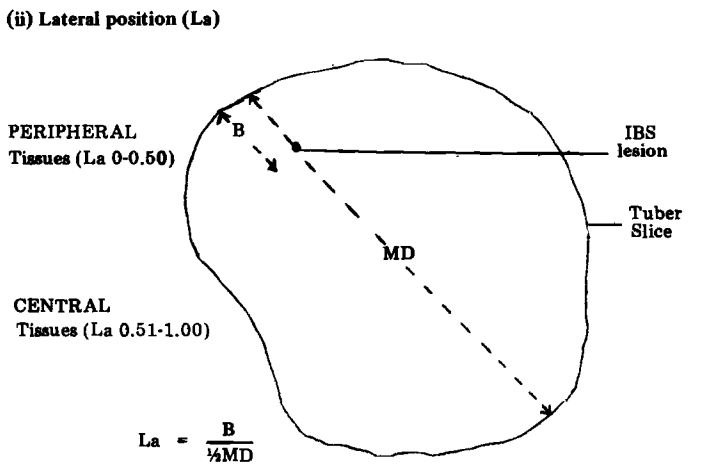


Fig. 1. Diagrammatic representation of measurements taken in determing the Longitudinal and Lateral distribution of IBS lesions in tubers of *D. alata* cv. White Lisbon.

RESULTS AND DISCUSSIONS

The distribution of IBS lesions in the batch of 300 tubers of *D. alata* cv. White Lisbon is summarised in Figs. 2 and 3. There appeared to be distinct patterns of distribution in both longitudinal and lateral directions. The majority of lesions were found in the middle regions of tubers (longitudinally) and were more frequent towards the periphery of the tuber (laterally). These results differ from previous observations which indicated that lesions were most common towards the head end, i.e. the oldest part, of tubers. However, as the bulk of tuber tissues appear to occur in the middle of White Lisbon tubers it might be expected that on average most lesions would be located in this region. It is probable that the White Lisbon material examined during earlier surveys was of a different clone to that sampled in this study. During slicing, it was observed that some tubers contained numerous (50 - 300 lesions/tuber), small (av. diam., 0.1 - 1.0 mm), dark-brown lesions while others in the same crop, had few (1 - 20 lesions/tuber), large (av. diam., 2.0 - 4.0 mm), light-brown lesions. Perhaps, different clones of White Lisbon have various types of symptom expression as do several cultivars of *Solanum tuberosum* L. when infected by certain potato viruses (Smith, 1972). Further work, therefore, is required to establish the distribution pattern of IBS incidence in different clones as well as in different cultivars of *D. alata*.

From the observations of Coursey (1967) it would appear that the distribution of lesions in tubers might be related to the age of tissues. However, data presented here suggest that lesion distribution is not wholly dependent on age of tissues because most lesions were found in the middle region of tubers (Fig. 2) and most frequently in the peripheral tissues of tuber slices (Fig. 3). It is assumed that the peripheral tissues of *D. alata* tubers are younger than the central tissues as young tubers appear to have a well-defined cambium-like layer in the tuber cortex (unpublished work). The same type of tuber development has been observed in young tubers of *D. floribunda* and *D. spiculifera* (Martin and Ortiz, 1963).

The size of lesions could possibly reflect their stage of development. Coursey (1967) reported that where numerous spots occurred in tubers, lesions appeared to be progressively smaller the further they were from the head end. The diameter of lesions observed during this study was recorded and a chi-square analysis of the collected date indicated that there was no significant association of lesion size with relative longitudinal position in the tuber (Table 1). It must be noted, however, that the tubers sampled in this stydy were only moderately affected with IBS (av. lesion number was 8/tuber; maximum lesion number was 35/tuber).

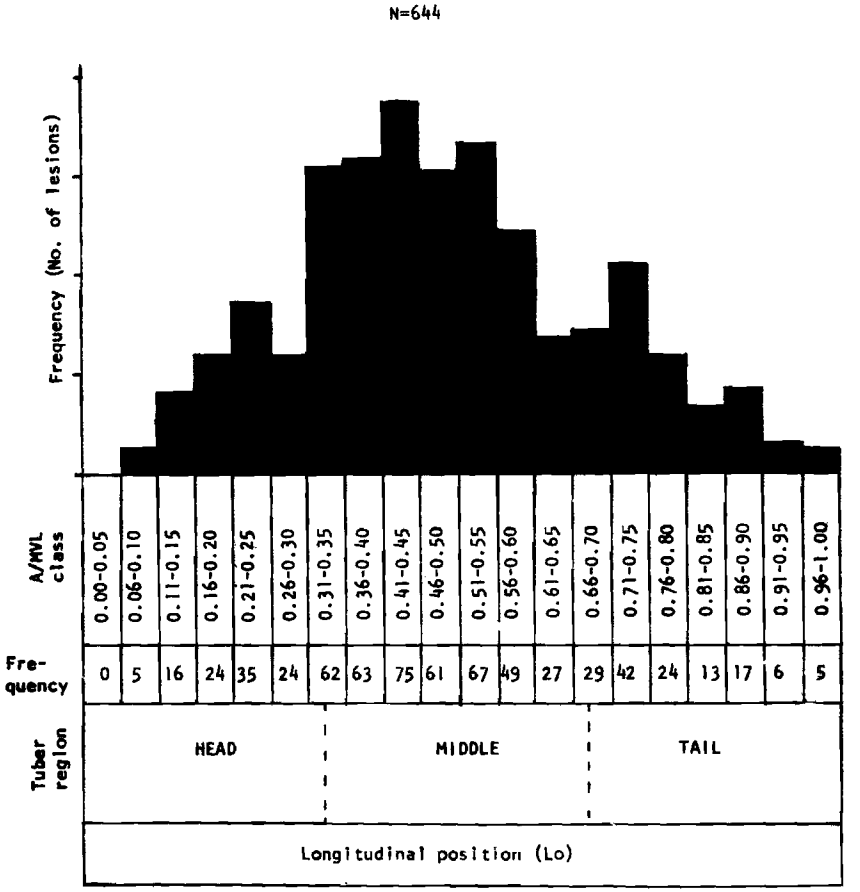


Fig. 2. Longitudinal distribution of IBS lesions in tubers of *D. alata* cv. White Lisbon

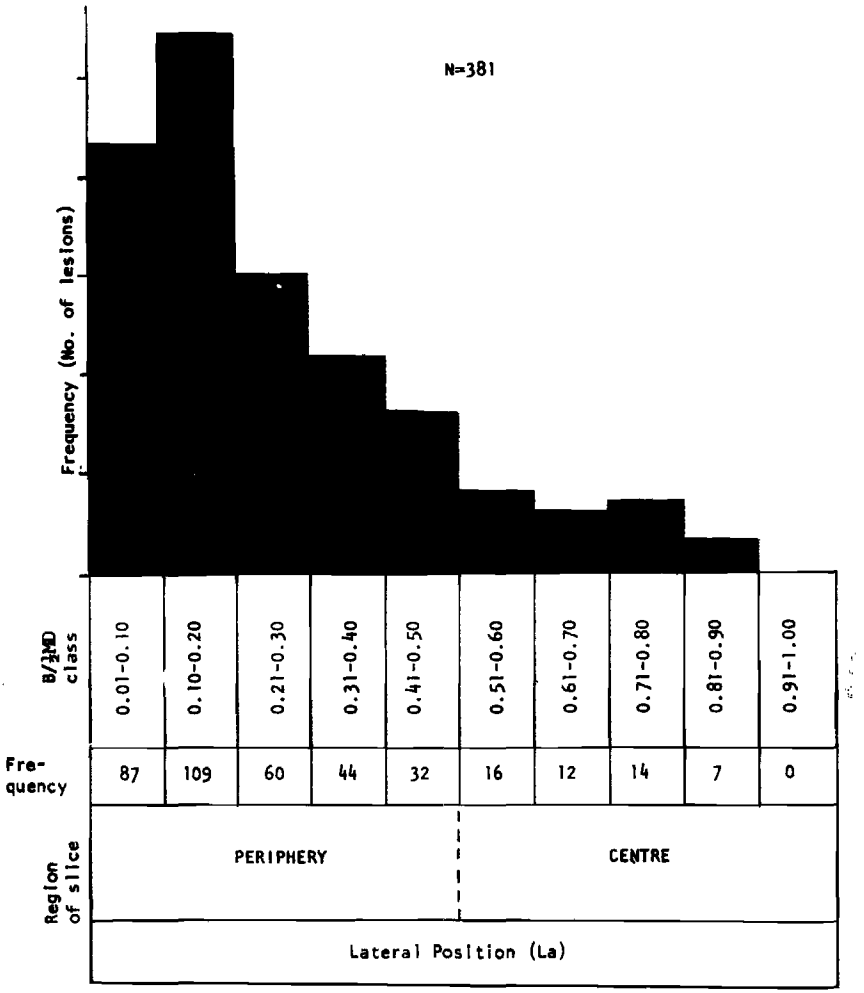


Fig. 3. Lateral distribution of IBS lesions in tubers of *D. alata* cv. White Lisbon

TABLE 1. Association of IBS lesion size with longitudinal position in *D. alata* cv. White Lisbon tubers.

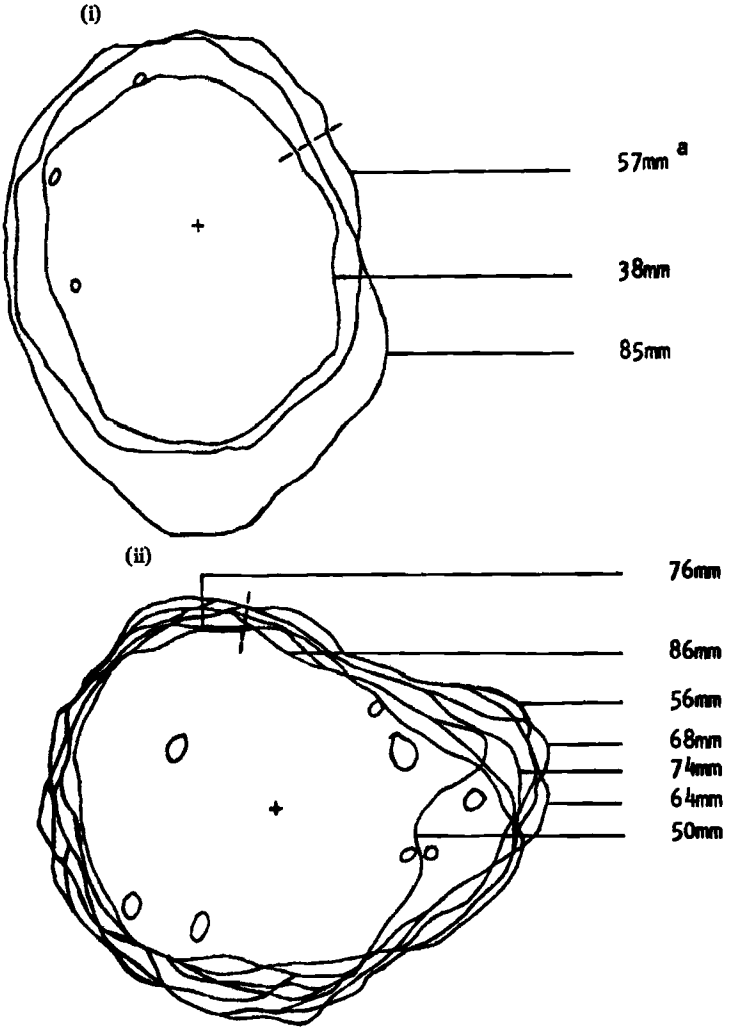
Region of tuber	Diameter of IBS lesion (mm) 0.1 - 1.0	1.5 - 3.0	3.5+
HEAD			
[b]Lo 0.01 - 0.33	[a]33	23	4
MIDDLE			
Lo 0.34 - 0.66	96	80	23
TAIL			
Lo 0.67 - 1.00	30	38	5

[a] Number of IBS lesions

Value of Chi-square = 5.30; N.S. at 5% level

[b] Ratio of distance from head: Maximum Vertical Distance (MVD)

The relative position of lesions mapped by tracing (Fig. 4, i) showed that lesions could occur on one side of tubers which suggested that infection might be localised. However, the dispersed type of distribution (Fig. 4, ii) was most commonly observed. The possibility of similar patterns occuring between tubers on the same plant was investigated. Frequency data (Fig. 5) indicated that mixed proportions of IBS-infected and IBS-free tubers per plant were common (72% in Barbados and 76% in Trinidad). A small proportion of plants (15% in Barbados and 7% in Trinidad) were completely free of IBS symptoms. It may have been that these plants were infected but symptomless. Until further electron microscope work has been completed the actual disease status of these plants remains obscure. Knowledge of this type of distribution pattern may help to answer certain problems concerning assessment of IBS incidence. For example, if batches of tubers are sliced to assess IBS in a crop, the apparent IBS would probably be low as compared to the incidence assessed on a plant to plant basis. Early surveys



Key: MVD axis (+)
Knife reference mark (*f*) ; IBS lesions (○)

a - Distance of slice from head

Fig. 4. Examples of tuber slice outlines used in determining the distribution pattern of IBS lesions in tubers of *D. alata* cv. White Lisbon by the tracing paper technique.

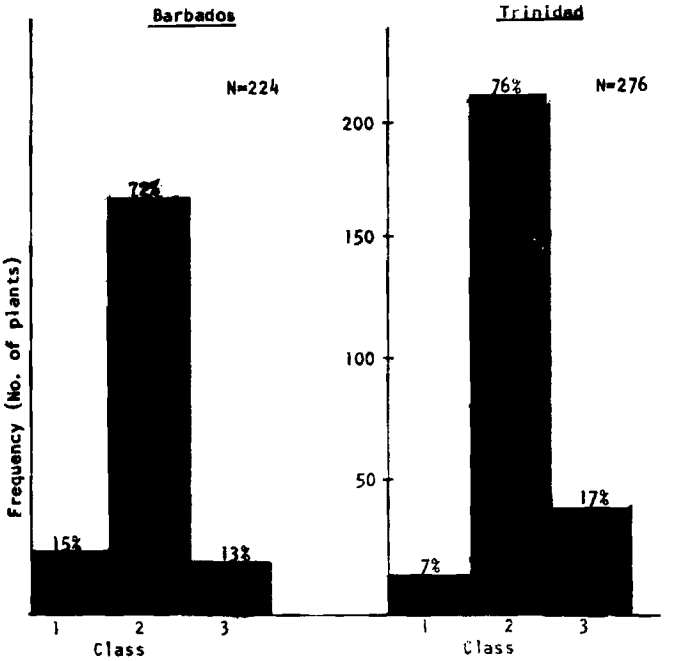


Fig. 5. The frequency distribution of IBS incidence in plants of *D. alata* cv. White Lisbon during 1974/75 season.

of IBD were carried out using small tuber samples e.g. 10 tubers selected at random per site (Jeffers and Headley, 1967). Consequently, these surveys might have produced misleading information and IBS could possibly be even more widespread in Barbados crops than originally estimated.

In the light of the information obtained from this study, modifications in the method of disease assessment have been made. IBS incidence in a crop or treatment is now assessed on a plant to plant basis and the Spotting Index per plant calculated using the method of Mantell *et al.* (1974) rather than taking random samples of bulked tuber material or sub-samples of tubers from individual plants. At present, work is being carried out to establish the disease status of the IBS-free tubers on plants with both infected and apparently IBS-free tubers. Furthermore, as there appears to be a definite pattern of lesion distribution in tubers the possibility of selecting apparently spot-free material is being investigated. Tubers have been sliced from the tail end and if lesions were not present in the tail and middle regions the tuber was considered apparently IBS-free and the head sett planted. In this way a comparison of disease in progeny plants of both apparently IBS-free and IBS-infected head setts has been made. Results of this work and related studies will be reported elsewhere.

ACKNOWLEDGEMENTS

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