Bunch orientation in plantain: A positive phototropic response.

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ORIENTATION DU REGIME CHEZ LE PLANTAIN : UNE REPONSE PHOTOTROPIQUE POSITIVE.

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RESUME - Les souches de rejets baïonnettes de plantain (*Musa* cv. AAB) sont asymétriques. Elles ont été utilisées comme matériel de plantation. Le côté de la souche opposé au point de rattachement antérieur avec la plante-mère est qualifié d'«extérieur» et le côté opposé est dénommé «intérieur».
Les plantes fleuries («porteurs») présentent des régimes orientés vers le côté «intérieur» dans des conditions de pénétration uniforme de la lumière. En modifiant l'espacement entre plantes dans le champ, et donc la pénétration de la lumière au travers du couvert foliaire, les régimes retomberont du côté de la plante le plus éclairé.

INTRODUCTION

Etiolated organs are very suitable experimental materials for studying phototropism. Pioneer work on this subject started with PAAL and WENT (PAAL 1919 ; WENT, 1928).

However, very few experiments have been performed on plants grown in light (CURRY, 1969) and no reports on this subject include plantain. The size of plantain is certainly a major constraint in such experiments.

Since the corm of 'sword' suckers is asymmetric (Fig. 1) it is possible to plant plantain corms with an identical orientation. This means that the side of the corm away from the mother plant (termed the outside) (Fig. 1) of all planted sword suckers points in the same direction. Consequently, the largest outgrowing sucker will emerge at the same place for all plants, i.e. on the outside (SWENNEN, 1984).

Each bud, and hence a sucker, is associated with a leaf, but at its opposite side (SKUTCH 1927 ; SKUTCH, 1932). Thus by orientating the corm, the outgrowth of suckers will be well known in advance, as will be their corresponding leaves. The angle between two successive leaves is an intrinsic factor but is not constant and has been the subject of several studies (SKUTCH, 1927 ; DE LANGHE, 1961 a ; SIMMONDS, 1966).

From DE LANGHE's work on the phyllotaxy of the banana, it became clear that the glomerules of the bunch are internodia (DE LANGHE, 1961 a). This means that the orientation of each hand of a bunch is predetermined in accordance with the phyllotaxy.

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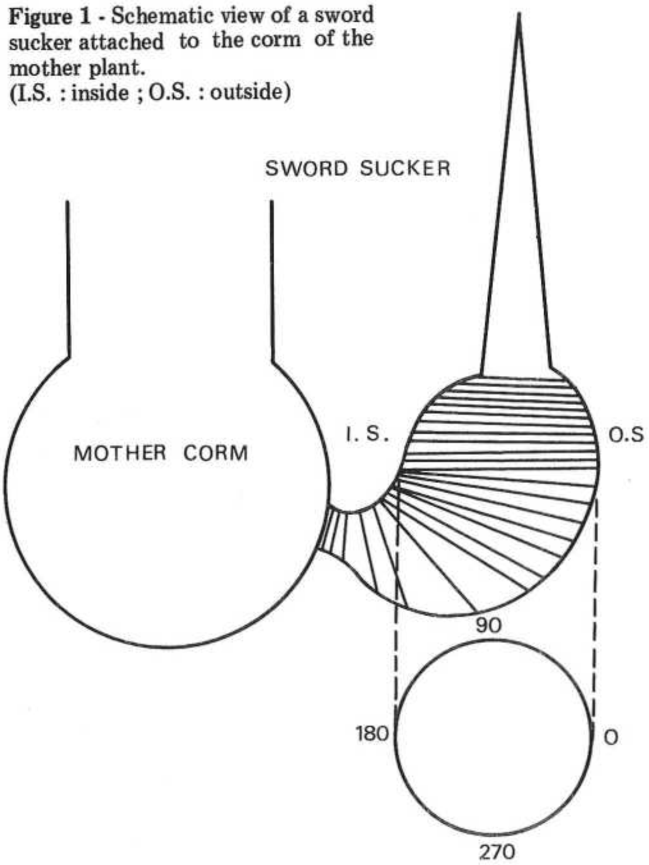
Figure 1 - Schematic view of a sword sucker attached to the corm of the mother plant.
(I.S. : inside ; O.S. : outside)



If we assume that the location of the first hand, and possibly of the other hands, will determine where the future bunch will hang down, identical orientation of planting material should result in identical bunch orientation since the glomerule of the first hand should then be orientated identically.

Light distribution in the field is affected by plant distance. If interline distance is different from interrow distance, there is an uneven light distribution which possibly affects any green organ, including the bunch.

The effects of corm orientation at planting and of light on the orientation of a bunch is the subject of this study.

MATERIALS AND METHOD

150 plantains were planted at the beginning of the rainy season at the ONNE-humid substation of IITA, in south-east Nigeria. The variety used is called «Agbagba» or «Libanga Likale» (DE LANGHE, 1961 b ; DE LANGHE, 1964). It is medium-sized False Horn.

Plants were fertilized at a rate of 300 kg N and 550 kg K_2O per ha per year applied at six weeks intervals during the rainy season. Furadan 10G, a nematicide-insecticide, was applied to the soil at 3 g active ingredient per year. Plants were mulched with *Pennisetum purpureum*.

Planting material consisted of sword suckers with the typical asymmetric corm.

An orthogonal projection of the outside (side of corm away from its mother plant) and inside (side of corm towards its mother plant) of the corm gives two points. The connecting line between these two points is the diameter of a circle with 0° at the outside and 180° at the inside (Fig. 1). This line or axis is kept orthogonal upon the interline of the plants. After several months of growth the corm becomes more or less symmetric but these two points of reference are maintained.

The plantains were divided in 3 groups of 50 plants. The first and second group were spaced at 2 m x 2 m with alternate interrow spaces of 4m while a third group was planted at 3 m x 2 m. In the latter group, all corms were identically orientated, the inside and outside being 3 m from the next corm. However, in the other two groups, one line of a pair was the mirror image of the other line. Whereas in the first group all the insides of corms pointed to the 4 m empty space, the opposite was the case for the second group.

The bunch orientation was determined using an orthogonal projection on the circle with inside-outside axis as diameter. Projection was carried out using a double plumb line which hung over the glomerule of the first hand. The mean of the 2 projected points was used. A line was drawn between that mean point and the centre of the plant, which is equivalent to the centre of the circle. The intersection of this line and the circle gives the orientation expressed in degrees between 0 and 360°.

RESULTS AND DISCUSSION

Bunch orientation as affected by orientation of planting material and uneven light distribution conditioned by distance to neighbouring plants is presented in three circular frequency distributions, one for each group of 50 plants (Fig. 2).

The first two frequency distributions (Fig. 2 A-B) clearly demonstrate the positive tropistic bunch orientation since the bunches point towards the 4 m empty space where there are no overlapping leaves and not towards the 2 m spacing where leaves overlap.

This positive tropistic response can also be observed on plantains growing in backyards. Their bunches tend to hang at the outside of each cluster, i.e. towards the light side.

In the case of 3 m x 2 m spacing, places where most

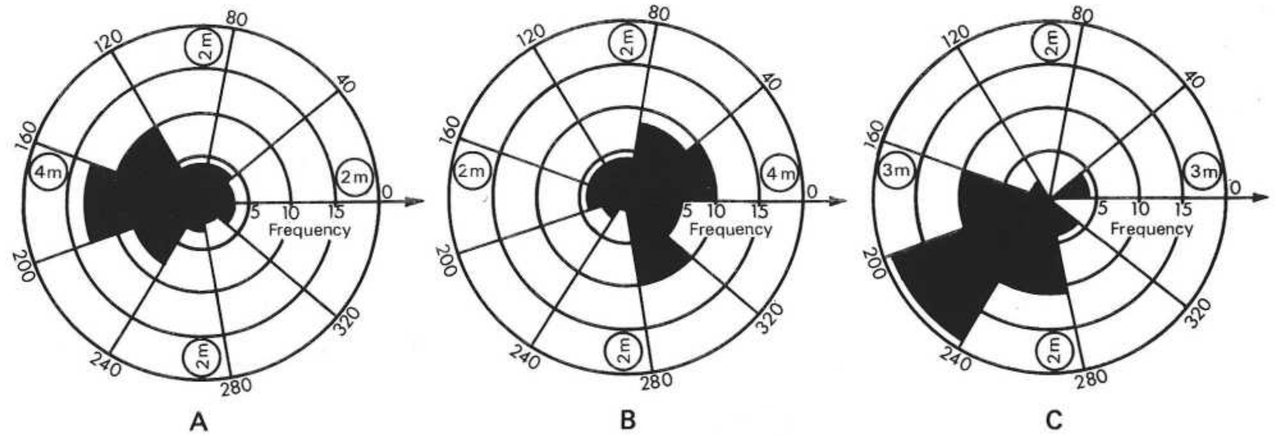


Figure 2 - Effect of uneven light distribution conditioned by distance to neighbouring plants on bunch orientation.

A. plants were planted in paired lines of 2 m x 2 m with the inside (I.S.) of the corm towards the next pair of lines at 4 m distance.

B. as A but outside (O.S.) of the corm points towards the next pair of lines at 4 m distance.

C. plants are planted 3 m x 2 m all having the same orientation.

(O.S. and I.S. are respectively at 0° and 180° ; numbers in meters indicate distance to neighbouring plants ; radius of the circle represents the frequency and the circumference the orientation).

light will penetrate the canopy are around $\alpha = 33.69°$, 146.31°, 213.69° and 326.31° (with tg α = 2 m/3 m) since overlapping is minimal there.

Consequently, a frequency distribution should show the highest frequencies in these four zones. However the bunches are only in the zone around 213.69° (Fig. 2 C). This indicates that there is a preference in bunch orientation pointing away from the outside of the planted corm.

It is likely that this positive tropistic bunch orientation, together with preferential orientation, causes torsion of the aerial stem. In other words, a just emerging bunch not pointing towards the most illuminated site of the plant, will turn to it resulting in the torsion of the stem.

The bunch orientation has some important agronomic consequencies. Firstly, it is established that the outside of the corm will bear the largest sucker at flowering (SWENNEN, 1984). This sucker will be the potential follower. A bunch at the opposite side would minimize the interception of light arriving on the sucker because the plant will lean towards its bunch.

An increase in distance between plants in order to increase the interception of light only at the outside, and thus for the ratoon, will be in vain because the bunch will then turn to that side. Therefore an increase in distance between plants should be in any direction (increasing both interrow-interline distance), and a hexagonal layout would be preferable to a rectangular layout.

Secondly, bearing plants usually lean because of the weight of their bunches. If bearing plants lean into the prevailing wind, plants will be less easily blown over as would occur in the opposite case.

CONCLUSION

Under field conditions plantains tend to have their bunches on the inside of the planted corm and thus opposite the place where the potential ratoon will grow out. However, this can be modified by the positive tropistic bunch orientation.

Orientation of sword sucker planting material and spacing are therefore important adjustable phytotechnical practices to avoid bunches hanging over their ratoon and bearing plants leaning away from the prevailing winds.

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