Bud Rot in Oil Palm Plantations: Link to Soil Physical Properties and Nutrient Status

By Alvaro Acosta and Fernando Munévar

Bud rot disease (BRD) is caused by a complex of fungal organisms and its development is regulated by interactions between the plant, pathogens, and the environment. Cases of BRD in Latin America have been documented in Colombia, Ecuador, Surinam, and Brazil. In oil palm plantations in Colombia, BRD is one of the main limitations affecting fresh fruit bunch (FFB) yield as well as quality of the extracted oil, which lowers the overall profitability of the plantation.

The majority of BRD cases are not lethal to oil palm. Affected plants, however, may require four months to three years to recuperate. During this time, plant production drastically declines. The typical symptom is yellowing of young leaves during the months of high rainfall and high relative humidity. Affected leaf tissue eventually becomes necrotic and dies as the disease progresses. The disease is most serious when growing meristematic palm tips are infected and the fungal pathogen is allowed to extend deep into plant tissues. Palms can recover from BRD if the infection is superficial. However, if enough plant tissue is affected, even implementation of drastic control measures such as heavy pruning usually fail to save the tree.

Soil Physical Properties

Research conducted by the Colombian Oil Palm Research Center (CENIPALMA) has shown that disease prevalence is higher where soil physical conditions are limited by:

Chlorosis of the youngest leaves, and drying and necrosis of the spear are initial symptoms of BRD in young palms.

Spears and young leaves become necrotic as the disease progresses. Young leaves look abnormally pale.

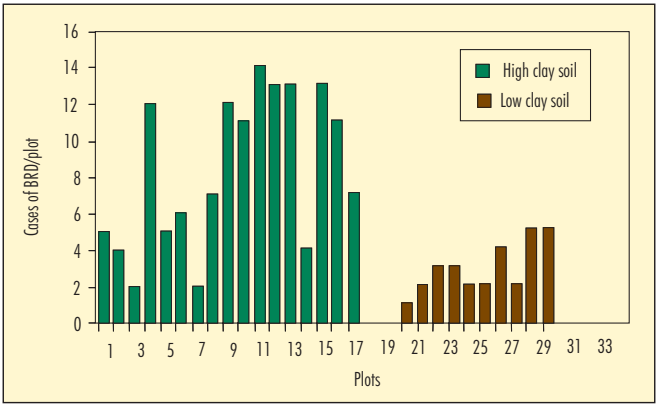

Figure 1. Cases of BRD infection in oil palm plantations located on soils with high and low clay content, Colombia.

- Clayey soils…plots with significant amounts of clay within the surface horizon (0 to 40 cm) often had double the incidence of BRD infection (**Figure 1**).
- Compaction…higher disease pressure is found in plantations with greater soil resistance to penetration (**Table 1**).
- Hydraulic conductivity…in-situ measurements of saturated hydraulic conductivity and total porosity in areas of contrasting disease pressure in Eastern Llanos demonstrate the negative relationship between BRD incidence, hydraulic conductivity, and soil porosity (**Table 2**).

Table 1. Soil compaction increases incidence of BRD in Colombian plantations.

Plantation	Soil resistance, kg/cm^2 High incidence	Low incidence
Palmas de Casanare	17.8	8.7
Inipalma–Parcela 1	16.1	11.8
Inipalma–Parcela 2	14.2	8.0
Manavire	18.5	16.3
Manuelita	14.0	10.0

Four plots at the Cumaral Plantation displaying early disease symptoms were selected to investigate the affect soil water drainage has on BRD. Treatments included improved drainage for two of the four plots and disease pressure was monitored in all plots for 22 months. There was significantly lower frequency of BRD in plots with improved drainage (**Figure 2**). Fifteen months after the study was initiated, researchers decided to

Table 2. Frequency of BRD decreases with increasing hydraulic conductivity and total porosity, Cumaral Plantation, Meta.

Site	Incidence of BRD, %	Hydraulic conductivity, cm/hr	Total porosity, %
1	70	0.55	44.8
2	38	0.56	46.9
3	5	3.85	72.2
4	3	4.21	47.8

Several spears and young leaves are affected in the same palm.

Palms can recover, but productivity is often reduced drastically.

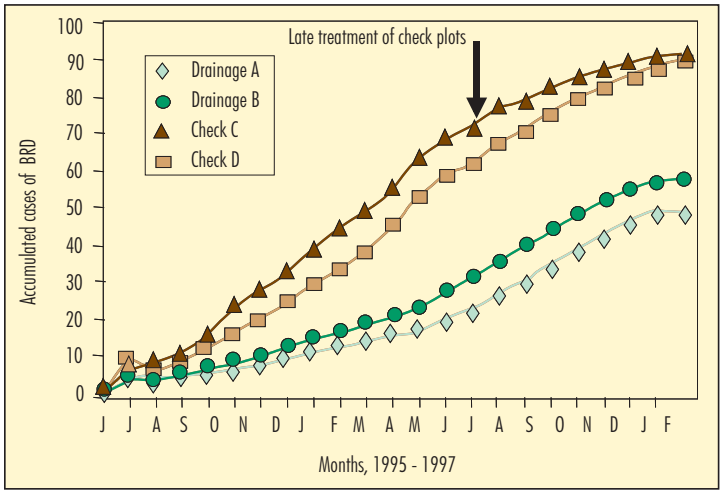

Figure 2. Effect of drainage on the BRD incidence, Santa Barbara, Cumaral Plantation, Meta.

improve the drainage in the previously non-treated plots—which consequently reduced the incidence of BRD. This recuperation is indicated by the change in slope of the two check plot lines and represents the accumulated cases of BRD in the two check plots.

Field observations in a wide variety of circumstances in the oil palm-growing areas of the eastern savannas and in Tumaco on the Pacific coastal plain indicate that BRD incidence is also related to various aspects of the site's nutritional status. Research at different sites suggested a tendency for BRD when soil nitrite (NO_2^-) concentrations are high. This tendency may be related to poor site drainage, because the presence of NO_2^- accumulation in soil is a symptom of prolonged anaerobic soil conditions.

Foliar nutrient deficiencies observed over a wide variety of plantations suggest a link between BRD and the nutritional status of the palm. Young palms (less than four years old) are often deficient in boron (B) or display 'leaf white stripe' symptoms—visual indication of an overly high ratio of nitrogen (N) to potassium (K) in the plant. Foliar analysis in affected sites has confirmed relatively high N:K as well as calcium (Ca):B ratios compared to nearby palms showing no symptoms.

Table 3. Soil test results from the palm circles of plants with and without BRD incidence, Manuelita Plantation, San Carlos de Guaroa, Meta.

Parameter	Plot 1 Infected plants	Plot 1 Healthy plants	Plot 2 Healthy plants
pH*	4.2	4.3	4.5
CEC, cmol (+)/kg*	6.29	7.21	7.83
Organic matter, %	2.3	2.4	2.6
Bray II-P, ppm[1]	24	28	28
K, cmol (+)/kg	0.16	0.18	0.23
Ca, cmol (+)/kg	0.45	0.66	0.69
Mg, cmol (+)/kg	0.23	0.32	0.31
S, ppm*	4.9	6.5	8.2
B, ppm*	0.1	0.2	0.2
Fe, ppm*	28.1	30.7	47.3
Cu, ppm*	0.2	0.2	0.5
Mn, ppm	7.9	12.6	10.2
Zn, ppm	0.1	1.3	1.4
Al saturation, %*	63	55	55

*Parameters which are significantly different by orthogonal contrasts.
[1] ppm = parts per million

The relationship between nutrient status and BRD was studied in soils without the physical limitations noted above. At the Manuelita Plantation at San Carlos de Guaroa, Meta, plot 1 had a low incidence of BRD plus healthy plants, while plot 2 had only healthy plants. Soil samples taken from the palm circles of both infected and healthy plants in both plots found that soil fertility status tended to be better in soils surrounding healthy plants (**Table 3**).

Foliar tissue from leaves 9 and 17 were sampled from the same plants where soil sampling was conducted. Foliar analysis of leaf 17 found no statistically significant differences between infected and healthy plants. However, values in healthy plants appeared closer to

standard critical values than infected plants (data not shown). Using leaf 9, foliar values of P, K, and copper (Cu) were statistically higher in visually healthy plants, but Ca and magnesium (Mg) were lower (**Table 4**). It was also found that ratios of N:K, Ca:K, N:P, and Ca:B were lower in healthy plants. These results suggest that an incorrect nutrient balance likely plays an important role in the incidence of BRD in oil palm. Since foliar analysis of leaf 17 could not show a clear relationship among BRD incidence and nutrient status of the plant, it is likely that symptoms of BRD initiate in the younger tissues and a better diagnosis is achieved by analyzing leaf 9.

This research demonstrates the importance of soil management in controlling bud rot disease. Good preventative management practices include establishment of adequate drainage and adequate, balanced fertility. BCI

Table 4. Foliar test results in leaf 9 of plants with and without BRD incidence, Manuelita Plantation, San Carlos de Guaroa, Meta.

	Plot 1		Plot 2
Parameter	Infected plants	Healthy plants	Healthy plants
N, %	2.52	2.61	2.50
P, %*	0.16	0.17	0.18
K, %*	1.11	1.20	1.44
Ca, %*	0.55	0.54	0.40
Mg, %*	0.35	0.32	0.26
S, %	0.17	0.18	0.17
B, ppm	13.1	12.9	13.9
Cu, ppm*	10.8	11.8	13.3
Fe, ppm	91.5	89.0	92.1
Mn, ppm	825	817	674
Zn, ppm	30.9	31.1	22.8
N/K*	2.29	2.19	1.73
Ca/K*	0.50	0.45	0.27
N/P*	15.8	13.4	14.4
Ca/B*	425	429	289

*Parameters which are significantly different by orthogonal contrasts.

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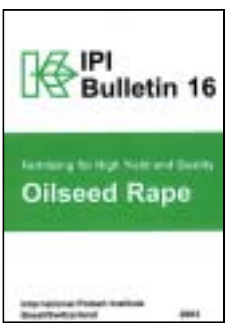
Oilseed Rape: Fertilizing for High Yield and Quality

Publication Available as IPI Bulletin



Oilseed rape is an important commodity on the international oilseed market, ranking second in production behind soybean. The major producers are China, the European Union, India, and Canada.

A publication now available from the International Potash Institute (IPI) on oilseed rape is a very comprehensive and highly informative brochure for extension workers, students, and scientists. IPI Bulletin No. 16 discusses the botany of rapeseed, together with the use of oilseed rape and the role of plant nutrients in yield and quality management. The main part of the Bulletin is devoted to the effect of fertilizer on yield and quality. The publication, authored by K. Orlovius, has 130 pages and also includes 68 figures, 31 tables, and seven color plates, together with more than 200 references.

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