ACCELERATING RESISTANCE BREEDING: VALIDATED *Ganoderma* SCREENING CONTROLS FOR THE OIL PALM INDUSTRY

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Basal stem rot (BSR), caused primarily by *Ganoderma boninense*, remains the most devastating disease affecting the oil palm industry (*Figure 1*). The disease causes severe yield losses, compromises plantation longevity, and increases replanting costs, ultimately threatening long-term productivity and sustainability (Idris, 2011). The development of *Elaeis guineensis* progenies resistant to *Ganoderma* may provide the ideal long-term solution for BSR, a major disease of oil palm in Malaysia (Idris et al., 2004). Despite extensive efforts to develop resistant planting materials, one of the major limitations in resistance breeding has been the absence of reliable and standardised reference materials to benchmark screening outcomes.

Figure 1. Oil palm infected with Ganoderma *basal stem rot (BSR).*

Screening oil palm progenies for resistance against *Ganoderma* is often lengthy, resource-intensive, and inconsistent between institutions and breeding programs. The lack of validated resistant and susceptible controls has resulted in difficulties in comparing screening outcomes, leading to uncertainties in selecting superior planting materials. Consequently, breeding decisions are often made without robust benchmarks, increasing the risk of advancing susceptible materials or overlooking potentially resistant progenies.

Recognising this challenge, Malaysian Palm Oil Board (MPOB) initiated a large-scale screening programme to identify standardised control materials for *Ganoderma* resistance screening. After five years of intensive research involving 13 batches of screening and materials from diverse genetic backgrounds, MPOB has successfully identified and validated three partially resistant and three susceptible oil palm cultivars. These materials demonstrated consistent disease response across repeated screening cycles and are now available as benchmark controls for industry adoption.

The introduction of validated screening controls marks a major milestone in accelerating resistance breeding and improving confidence in *Ganoderma* screening programmes across the oil palm industry.

THE TECHNOLOGY

The technology developed by MPOB focuses on the deployment of scientifically validated oil palm progenies as standardised controls in *Ganoderma* resistance screening programmes. Controls consisting of three partially resistant and three susceptible materials were identified and have undergone repeated validation to confirm their disease response consistency.

The screening programme was initiated in 2021 under a large-scale research initiative involving more than 160 crosses originating from different genetic backgrounds. A standardised screening system was established using a modified seed germination technique (Breton et al., 2006) and uses a reference *G. boninense* isolate known as PER 71 to ensure consistency in disease challenge conditions. Screening across 13 batches and assessing a total of 168 crosses, enabled the identification of specific crosses with stable resistance and susceptibility responses, as shown in *Table 1*.

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The validity of the breeding materials' tolerance and susceptibility was determined by measuring the survival rate against an index that takes into consideration the disease development physiology, such as foliar symptoms. The observed results were then tested against the survival rate and were found to correlate significantly with the parameters set for disease development in each screening batch (*Figure 2*).

These cultivars function as reference anchors in screening programmes. By incorporating known resistant and susceptible standards into every screening trial, researchers and breeders will be able to benchmark disease progression, normalise results across experiments, and compare progeny performance with greater confidence.

The technology transforms screening from a relative and often inconsistent assessment into a standardised, evidence-based decision-making process. Instead of relying solely on absolute disease severity or survival percentages, new breeding materials can be directly evaluated against validated performance standards, significantly improving reproducibility and reliability.

WHO WILL BENEFIT?

This technology is highly beneficial to stakeholders involved in seed production, oil palm breeding and disease management. Oil palm breeding programmes will benefit substantially through improved accuracy in selecting resistant materials. Breeders can rapidly identify promising progenies while eliminating highly susceptible candidates at an earlier stage, reducing unnecessary investment in weak breeding lines. Seed producers and commercial planting material developers can utilise the controls to validate their own screening programmes, thereby improving confidence in the selection of resistant material before commercialisation. Plantation companies and

TABLE 1. DETAILS OF IDENTIFIED OIL PALM PLANTING CULTIVARS THROUGH SCREENING PROGRAMME

Characteristic	Cross code	Background
Partial resistance	PK 7478	CD x NGA
	PK 7462	CD x NGA
	KTG 594	CD x (ZRE x AV)
Susceptible	TUP 1720	CD x (NGA x AV)
	PK 7537	CD x NGA
	KTG 615	CD x (ZRE x AV)

Note: CD - Chemara *Dura*; NGA - Nigeria; ZRE - Zaire; AV - AVROS.

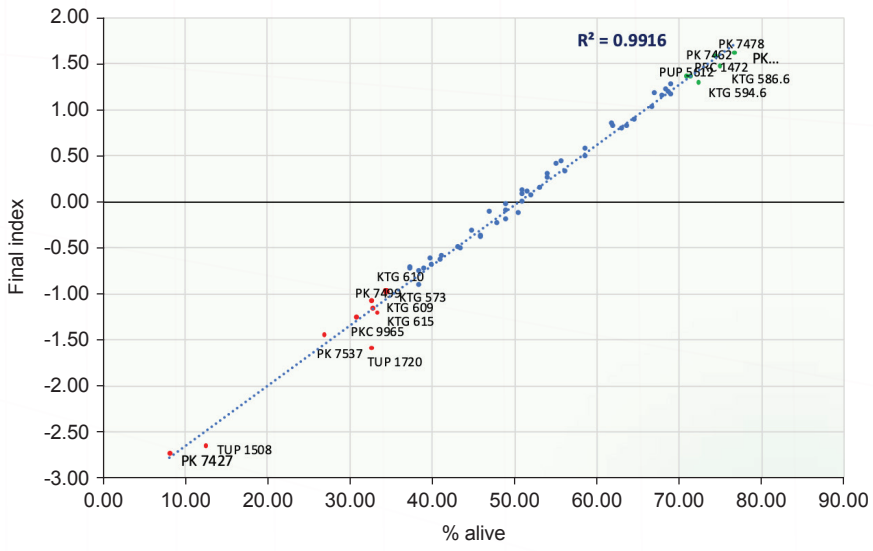

Figure 2. Correlation between progeny performance (survival rate) against the indexing of seedling physiology parameters – R^2=0.9916.

research institutions conducting independent assessments of *Ganoderma* resistance will also benefit from access to standardised benchmarks. The use of common controls enables meaningful comparisons across screening trials between research organisations, strengthening national datasets and collaborative research efforts.

Ultimately, the entire oil palm industry stands to gain through accelerated development of more resilient cultivars, reduced disease losses, improved plantation productivity, and greater sustainability.

SERVICE OFFERED

MPOB is now offering the validated screening controls to industry players interested in strengthening their *Ganoderma* resistance screening programmes. Two modes of engagement are available:

i. Provision of Validated Screening Controls
Industry partners conducting their own in-house screening programmes may obtain the validated partially resistant and susceptible cultivars to serve as reference controls. These cultivars can be incorporated into existing screening protocols to benchmark disease response and improve result interpretation.

ii. Participation in MPOB Screening Programme
Industry players may also opt to participate directly in MPOB's screening programme. Through this collaborative approach, breeding materials can be screened alongside MPOB's validated controls using established protocols and standardised conditions. This option enables organisations to benefit from MPOB's expertise, infrastructure, and accumulated research experience.

In addition to strengthening individual screening efforts, collaborative participation contributes towards developing more robust national datasets for *Ganoderma* resistance evaluation and accelerates resistance discovery at the industry level.

BENEFIT AND ADVANTAGES

The adoption of validated screening controls is expected to significantly improve the effectiveness of *Ganoderma* resistance breeding programmes.

- **Faster Decision Making** – Users can expect faster and more informed decision-making. The presence of resistant and susceptible standards allows rapid identification of superior breeding materials while minimizing the advancement of poor-performing progenies.

- **Improved Screening Accuracy** – Screening accuracy and consistency are greatly improved. Since every screening exercise is anchored to validated benchmarks, variability between trials is reduced, increasing confidence in interpretation and selection decisions.

- **Significant Time and Cost Savings** – The technology enables cost and time savings. By eliminating susceptible materials earlier in the breeding pipeline, organisations can avoid prolonged field evaluations and unnecessary resource allocation.

- **Scalable Across Programmes** – Users can expect a scientifically proven and scalable system. The technology is supported by five years of large-scale validation involving repeated screening cycles and diverse genetic materials, demonstrating consistent disease response patterns suitable for broad application across breeding environments.

- **Scientifically Proven Confidence** – Built upon five years of intensive research and repeated validation involving more than 160 crosses, the technology provides reproducible and reliable disease response standards for the industry.

Overall, the technology provides a practical pathway towards rapid identification of truly resistant oil palm materials and accelerates the development of disease resilient cultivars materials for future plantations.

IMPACT

The successful identification of validated partially resistant and susceptible oil palm cultivars represents an important advancement in *Ganoderma* resistance breeding. These controls provide the industry with a standardised benchmark for more reliable and meaningful screening outcomes. By integrating validated controls into screening programmes, the oil palm industry can transform resistance assessment

from a relative exercise into a standardised, decision driven process. This enables faster elimination of susceptible materials, improved confidence in breeding decisions and accelerated development of resistant planting materials. MPOB now invites industry players to adopt this technology, integrate validated controls into their screening systems, or collaborate directly through MPOB's screening programme.

CONCLUSION

MPOB is committed to supporting industry adoption through the provision of validated controls and collaborative screening services. Through strategic partnerships, the industry can collectively strengthen resistance breeding efforts and secure long-term productivity against the continuing threat of BSR.

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