Journal of Tropical Resources and Sustainable Science
Website : http://journal.umk.edu.my/index.php/jtrss/
eISSN : 2462-2389
Vol: SI Issue 1, 2025, 203-209
DOI: https://doi.org/10.47253/jtrss.v13i3.2020

RESEARCH ARTICLE

Agronomic performance and resistance traits of Abaca Hybrid 7 (*Musa textilis* Nee) in the field

Elizabeth P. Parac[1], Edgar P. Nabo[1], Sheila C. Polbo[1], Bernard C. Havana[1], Crishelo B. Cabillo[1], Antonio B. Lalusin[2], Ma. Kuh Shiela Anne T. Ladera[3]*

[1]Department of Plant Sciences, College of Agriculture and Agri-Industries, Caraga State University, Ampayon, Butuan City, Philippines
[2]Institute of Crop Science, College of Agriculture and Food Science, University of the Philippines, Los Baños, College, Laguna
[3]Department of Agroforestry, College of Forestry and Environmental Science, Caraga State University, Ampayon, Butuan City, Philippines

ARTICLE HISTORY
Received : 27 July 2025
Accepted : 27 October 2025
Online : 31 December 2025

KEYWORDS
Bandala
Inosa
Tinawagang Pula
Abaca Bunchy Top Virus

⌧* CORRESPONDING AUTHOR
Ma. Kuh Shiela Anne T. Ladera
Department of Agroforestry, College of Forestry and Environmental Science, Caraga State University, Ampayon, Butuan City, Philippines
E-mail: mtladera@carsu.edu.ph

ABSTRACT

The abaca ((*Musa textilis* Nee) industry is a vital contributor to employment and foreign exchange in the Philippines, but its productivity is increasingly threatened by viral diseases, particularly abaca bunchy top virus (ABTV). This study aimed to evaluate the agronomic performance and disease resistance of newly developed ABTV-resistant abaca hybrids under screenhouse and field conditions. Tissue-cultured plantlets were assessed for key agronomic traits, including pseudostem weight, length, and girth; dry fiber weight; percent fiber recovery; and sucker production. Disease resistance was evaluated through symptom observation and confirmed using ELISA and PCR diagnostics. Results indicated that the hybrids matured earlier (10–14 months) after planting. Notably, abaca hybrid Bandala (H7) outperformed Inosa with longer pseudostem (240–250 cm), larger middle girth, top girth size, and a larger base girth, and 16 suckers produced over 11.Similarly, Abaca Hybrid 2 (H2) exhibited a statistically significant difference compared to Bandala (H7) and Tinawagang Pula with fiber recovery of 1.05%, 0.8% and 0.6%, respectively. Additionally, hybrids exhibited complete resistance to ABTV, showing no symptoms and testing negative via PCR using the primer BBT1 and BBT2 that amplify the 348 bp fragment of DNA-R genome component.The absence of infection was confirmed by PCR using an internal control that detects the presence of *Musa* sequence. Hybrids also showed partial resistance to abaca mosaic and bract mosaic viruses under high disease pressure. These findings highlight the potential of virus-resistant abaca hybrids to improve yield, reduce disease losses, and support the long-term sustainability of abaca industry.

1. INTRODUCTION

"Abaca (*Musa textilis* Nee.) is a fiber crop endemic to the Philippines" (Barbosa et al.,2023) and most productive in volcanic, well drained clay loam soils under humid tropical conditions which are ideal for cultivation. Widely recognized for its versatile fibers, abaca is primarily utilized in producing cordage, textiles, and various handicrafts. "Abaca pulp is used by the paper industry for such specialty uses such as tea bags, banknotes and decorative papers" (Simbaña et al., 2020). In particular, abaca fiber reinforced composites which are widely explored for a variety of applications in automotive and other industries (Kurien et al. 2023). As global demand for biodegradable and eco-friendly products increases, the abaca industry is expected to continue receiving both domestic and international support, contributing to environmental conservation.

According to Señiris (2024), "The Philippines holds the top position globally when it comes to exporting abaca fiber" which contributes to the country's continued dominance in the market. "The Philippines remains the leading producer of abaca fiber, contributing about 85% of the global abaca supply, while Ecuador accounts for approximately 14%"as cited by Bales et al., 2025. The abaca industry is a significant source of foreign income and a key export commodity for the country. Domestically, pulp and paper industry have over 80% of fiber usage, with consistent growth attributed to rising global demand for eco-friendly products such as tea bags, cigarette papers and currency notes (Grand View Research,2024; PCAARRD,2025).

According to the Philippine Statistics Authority

(2023), Bicol Region accounted for 33.9% of total abaca fiber production in Quarter 2, producing approximately 5.99 thousand metric tons. While Eastern Visayas and Caraga followed with 16.3% and 13% shares respectively, with the regions collectively contributing about 64.1% of national output. However, the future of the abaca industry faces significant challenges, particularly due to a series of devastating viral diseases, including bunchy top, mosaic, and bract mosaic. The most damaging viral infection impacting abaca production in the Philippines is the abaca buncy top virus (ABTV), which exceeds the threat level of mosaic and bract mosaic viruses (Mati-om et al., 2022,2024). As cited by Mati-om, Gapasin, and Piamonte (2020), Bicol and Eastern Visayas were major hotspots for ABTV, with fiber losses reaching 153, 186 kg in Northern Samar and 116,280 kg in Northern Leyte.

In response to these challenges, the Department of Science and Technology (DOST), through the Philippine Council for Agriculture, Aquatic, and Natural Resources Research and Development (PCAARRD), has supported a project under the Abaca Industry Strategic S&T Plan (ISP) aimed at rehabilitating abaca plantations. This project, titled "Rehabilitation of Abaca Plantation Through Adoption of High Yielding and Virus-Resistant Abaca Hybrids", seeks to mass-produce and promote high-yielding, virus-resistant hybrids developed by the University of the Philippines Los Baños (UPLB) and its partners (Lalusin et al., 2015; Abustan,2012). For two years, UPLB has implemented this initiative in collaboration with several institutions, including Visayas State University (VSU), University of Southern Mindanao (USM), Bicol University (BU), Western Mindanao State University (WMSU), University of Southeastern Philippines (USeP), Caraga State University (CSU), and Catanduanes State University (CSU).The project's primary goal is to produce hybrid abaca planting stocks through tissue culture techniques, address the demand for these planting materials, and evaluate the performance and stability of the hybrids in various locations. Additionally, the project has trained personnel in tissue culture technology to further support the mass production of these hybrids.

Despite its economic importance, the full potential of the abaca industry remains not well explored, particularly in enhancing the livelihoods of abaca farmers, many of whom belong to marginalized sectors and live below the poverty line. To tackle this, it is essential to improve abaca farm productivity by reducing the impact of viral diseases, especially the abaca bunchy top virus. Promoting a package of sustainable farming technologies will be crucial in enhancing the quality of life for abaca farmers and revitalizing the industry. Rehabilitation efforts are expected to directly involve abaca farming families and indirectly generate employment in related sectors. Thus, the study aimed to evaluate the agronomic performance of newly developed abaca hybrids resistant to abaca bunchy top virus (ABTV) and their susceptibility to common viral diseases such as mosaic and bract mosaic.

2. MATERIALS AND METHODS

2.1. Evaluation of Agronomic Performance of BTV-resistant Abaca Hybrids Against Other Diseases

Tissue-cultured abaca plantlets were assessed for resistance to mosaic virus, bract mosaic virus, and Sigatoka under both greenhouse and field conditions. In the greenhouse, plantlets were mechanically inoculated with sap from mosaic-infected plants. To facilitate inoculation, a pinch of Celite was added to the sap to enhance wounding. The sap was then gently rubbed onto the younger leaves of the plantlets, after which it was washed off with water (Hull,2014). Symptoms were monitored following inoculation, and leaves showing no visible symptoms were collected for further analysis. The sap from symptomless leaves was extracted using a mortar and pestle, and polymerase chain reaction (PCR) was employed to detect the presence of the virus, (Mati-om, Mati-om, & Piamonte, 2022). Plantlets that tested negative for the virus by PCR were further micropropagated (Parac et al.,2020) and retested.

In the field, agronomic data such as disease incidence, plant height, weight at harvest, and fiber recovery were collected through multi-location trials established during the conduct of the study.

2.2. Characterization and Evaluation of Abaca Hybrids for Resistance to Bunchy Top and Mosaic Diseases in the Field

Abaca hybrids #2 and #7, along with the control varieties Inosa and Tinawagang Pula, were evaluated for resistance to bunchy top and mosaic diseases. A field experiment was carried out at the Caraga State University Experimental Area (2500 m²), where the occurrence of the bunchy top virus was monitored. The experiment followed a Randomized Complete Block Design (RCBD) with four treatments: Treatment 1 (T1) - Abaca hybrid #2, T2 - Abaca hybrid #7, T3 - Inosa, and T4 – Tinawagang Pula. Each treatment was replicated three times with six plants per replication. The plants were allowed to undergo natural infection, and the disease incidence was observed.

Resistance to diseases was assessed by examining disease incidence and virus levels in the plants. Both diseased and symptomless plants were collected and transported to the laboratory for virus detection using Enzyme-Linked

Immunosorbent Assay (ELISA) (Sta. Cruz et al., 2017) and Polymerase Chain Reaction (PCR) using the primer BBT1 and BBT2 (Thomson and Dietzgen1995) that amplify the 348 bp fragment of DNA-R viral genome component. The absence of infection was confirmed by PCR using an internal control that detects the presence of *Musa* sequence(Sharman, Thomas & Dietzgen,2000).

3. RESULT AND DISCUSSION

3.1. Evaluation of Agronomic Performance of BTV-resistant Abaca Hybrids

The average performance of the abaca hybrids was analyzed based on six parameters: pseudostem weight, pseudostem length, pseudostem girth, dry weight of fiber, percent fiber recovery, and number of suckers per mat (Figures 1-4). The control was observed to mature much slower than the abaca hybrids. Harvesting of hybrids started as early as 10-14 months after planting while the control was harvested much later especially in open field trials.

3.1.1. Average field performance based on pseudostem length and weight of Bandala (H7) and Inosa

Figure 1 outlines the comparison of two abaca varieties: Bandala (H7 hybrid) and Inosa across three treatments in terms of pseudostem length (cm) and pseudostem weight (g). Notably, abaca hybrid Bandala (H7) consistently showed greater pseudostem length than Inosa. T3 shows the highest pseudostem length for both varieties, with Bandala (H7) reaching nearly 250 cm, indicating that T3 may be the most favorable treatment condition for growth. Additionally, hybrid variety exhibited a pseudostem length range from approximately 240 cm (T1 and T2) to 250 cm (T3), while Inosa ranged from about 180-205cm.This suggest that the Hybrid Bandala (H7) has a superior vegetative growth compared to Inosa, potentially making it suitable option for fiber production in field conditions.

Similarly, the recorded pseudostem weight (g) for Hybrid Bandala (H7) and Inosa across three treatments revealed that the hybrid variety outperformed Inosa.The highest pseudostem weight for Bandala was observed under T2 and T3 with 14 kgs, indicating stable performance among treatments.In contrast, Inosa shows more variation, with the highest weight recorded under T2 with 10 kgs and the lowest was T1 with 5 kgs.The data that Bandala is more robust and consistently produces heavier pseudostems , which is important for fiber yield, as pseudostem biomass directly contributes to fiber quantity and quality.

These findings were consistent with previous studies that reported Bandala (H7) exhibiting superior growth performance and morphological traits, including pseudostem height across different agro-ecological zones in the Philippines (Sison, Villegas, & de Vera, 2020; Bandala & Aquino,2021; PhilFIDA, 2023). According to the DOST-PCAARRD (2021) terminal report, Bandala (H7) showed higher pseudostem length and weight, making it suitable for enhanced fiber yield under field settings. In addition, Patalinghug et al., 2020, emphasized that hybid abaca Bandala (H7) consistently shows superior pseudostem growth compared to traditional varieties such as Inosa.

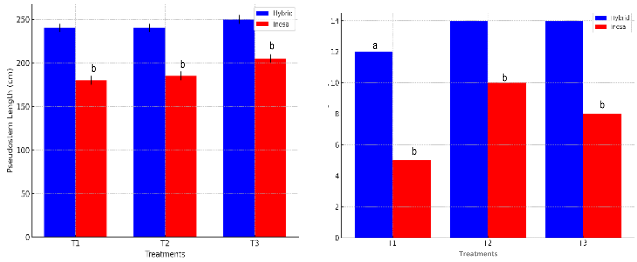

Figure 1. Average field performance based on pseudostem length (A) and weight (B) of Bandala and Inosa.

3.1.2. Average field performance based on pseudostem girth measurements of Bandala (H7) and Inosa

Based on Figure 2, which highlights the average field performance of two abaca cultivars: Bandala (H7 hybrid) and Inosa across three treatments in terms of pseudostem girth measurements. The results clearly demonstrate that Bandala (H7) consistently recorded 36 cm across all treatments with thicker pseudostems in the middle portion, which contributes to better mechanical support and greater fiber volume compared to Inosa with a gradual increase from 24-29 cm. Meanwhile, Bandala (H7) maintains a more robust upper pseudostem diameter ranged from 26-27 cm over Inosa with 21-24 cm. Also, Bandala (H7) reveals a thicker base girth among all treatments with a steady increase from T1 to T3. In contrast, Inosa remains significantly lower in T1 and T2 with 32 cm recorded and shows a slight increase in T3 with 39 cm. This consistent superiority reflects enhanced vigor, structural integrity, and potential for higher fiber yield. This finding aligns with the results of Villegas, Sison, and de Vera (2016), who found that Bandala hybrids demonstrated significantly improved girth and morphological traits under field conditions. Similarly, Dizon and Arevalo (2014) observed superior pseudostem dimensions in hybrid varieties compared to traditional cultivars such as Inosa.

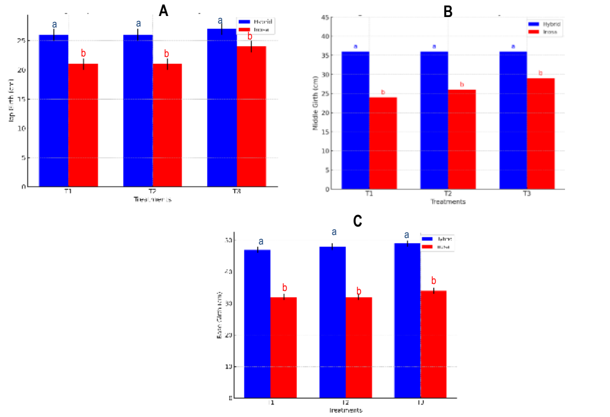

Figure 2. Average field performance based on pseudostem girth measurement of Bandala (H7) and Inosa.

3.1.3. Average field performance based on number of suckers produced of Bandala (H7) and Inosa

As shown in Figure 3, the average field performance of Bandala (H7) and Inosa were evaluated based on the number of suckers produced. Result shows that Bandala (H7) produced an average number of 16 suckers which is notably higher compared to Inosa with 11 suckers among all treatments. Hybrid Bandala (H7) recorded T1 with 14 suckers, T2 and T3 with 16 suckers while Inosa had produced suckers of 12,10, and 11 for T1,T2 and T3, respectively.Hybrid variety in T2 and T3 significantly different in the suckers produced over Inosa. On the other hand, in T1 they were not significantly different. This indicates a more vigorous vegetative propagation potential of Bandala, which is advantageous for plantation establishment and sustainability.Comparable observations were made by Dizon and Arevalo (2014), who reported that abaca hybrids including Bandala, revealed superior sucker production compared to traditional varieties.Similarly, Villegas, Sison, and de Vera (2016), as well as Ramos and Estigoy (2012), noted the enhanced tillering capacity and vegetative vigor of Bandala hybrids varying field conditions.

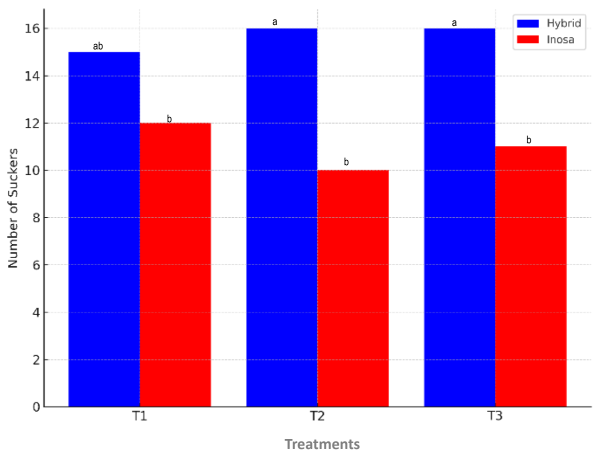

Figure 3. Average field performance based on the number of suckers produced by Bandala (H7) and Inosa.

3.1.4. Average field performance based dry weight and fiber recovery of Bandala (H7) and Tinawagang Pula

Figure 4 illustrates the average field performance of two Abaca Hybrids (H2 and H7), and Tinawagang Pula in terms of dry weight (g) and fiber recovery (%). Abaca Hybrid 2 (H2) exhibited a statistically significant difference compared to Bandala (H7) and Tinawagang Pula, indicating its superior biomass accumulation under the given field conditions. On the other hand, Bandala was not significantly different to Tinawagang Pula. These trends are consistent with observations from larger, multi-site trials that highlight H2's greater over-all vigor and biomass compared to traditional varieties (Parducho et al.,2023; Parac et al.,2020).

Based on fiber recovery, Abaca Hybrid (H2) was not significantly different with Tinawagang Pula. However, there was a significant difference between Hybrid (H2) and Tinawagang Pula to Bandala (H7). Tinawagang Pula recorded a 1.05% followed by Abaca Hybrid (H2) with 0.8%, and Bandala (H7) with 0.6%.Furthermore, Tinawagang Pula's superior fiber recovery suggests it is more efficient in converting biomass into usable fiber which is usable for commercial fiber production. While Abaca Hybrid (H2) had moderate fiber recovery, still indicates decent fiber output but slightly less efficient than Tinawagang Pula. Bandala (H7) suggests relatively lower fiber yield per harvested pseudostem, which might affect its profitability or processing preference unless offset by other favorable traits. This result conforms to the findings of Dela Peña and Manila (2011) which they emphasized that fiber recovery in abaca hybrids typically ranges between 0.5% and 1.2%, depending on genetic fiber recovery values that are advantageous for fiber production efficiency and economic return. As cited also by Barcelona, J.M, and Dizon, T.O. (2019), their study highlights that fiber recovery values among tested hybrids ranged from 0.6% to 1.2%, confirming that varietal differences significantly affect fiber yield and recovery efficiency. In addition, the study reported by Ramos, H.C., and Peralta, J.P. (2018), fiber recovery percentages between 0.5 % and 1.1% identified cultivar – level differences in fiber extraction efficiency as key indicators for cultivar selection.

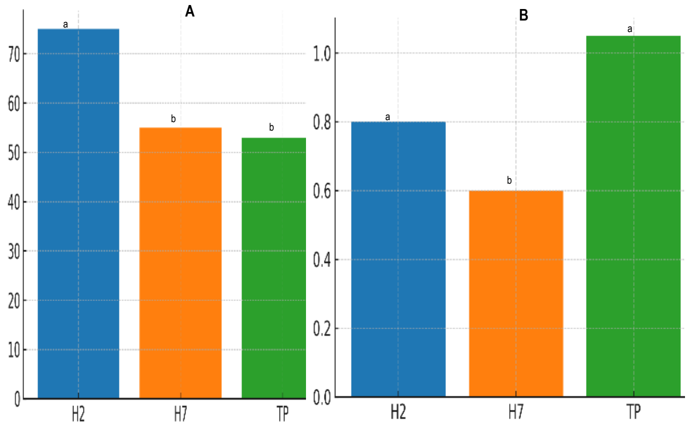

Figure 4. Average field performance based on dry weight (A) and fiber recovery of Bandala (H7) and Tinawagang Pula.

3.2. Characterization and Evaluation of Abaca Hybrids for Resistance to Bunchy Top and Mosaic Diseases in the Field

The resistance of hybrids under field conditions was assessed and characterized by comparing the disease development of these hybrids with that of the susceptible control varieties (Parac, Sta.Cruz, & Lalusin, 2021). The incidence and virus levels in plants were used to characterize the resistance of these hybrids. Disease incidence was determined by visually observing symptoms, and infection was confirmed through PCR detection.

The abaca hybrids did not exhibit any visible symptoms of bunchy top compared to the two susceptible varieties, "Inosa" and "Tinawagang Pula." "Inosa" and "Tinawagang Pula," which are susceptible to bunchy top, only displayed visible symptoms of the disease as shown in Figure 5. Similar trends were observed by Abad, R.G., and Dela Cruz, T.E (2021), compares symptom expression in hybrids and traditional varieties; where hybrids showed no symptoms, while susceptible ones showed stunting, streaks, and chlorosis. "Inosa" exhibited a characteristic symptom of dark green streaks on the leaf veins, midribs, and petioles, which progressed into severe marginal chlorosis and severe bunchy top characterized by upright, crowded, and brittle leaves at the apex of the plant.This findings align with the study of Magnaye and Espino (2020), who describes typical ABTV sysmptoms such as dark green streaks on petioles and veins, marginal chlorosis, and upright, brittle leaves." Severe cases led to upright and brittle leaf growth, characteristic of bunchy top syndrome"(Sison & Aquino,2023). "Tinawagang Pula" on the other hand, had characteristic symptom of dark green streaks on the leaf veins, leading to severe marginal chlorosis that developed into severe bunchy top, accompanied by dwarfing of leaves. This supports the results reported by Abad & Dela Cruz,2021; Sison and Aquino,2023 where they cited that "Tinawagang Pula" displayed symptoms such as dark green streaking on the veins, leaf dwarfing, and severe marginal chlorosis, indicative of late-stage ABTV infection. Also, according to Villamor & Santos,2018; PCAARRD,2019, they reported that "Tinawagang Pula" exhibit upright, crowded leaves at the apex, chlorosis, and dwarfism.

Figure 5. Bunchy top disease symptom on abaca hybrids and susceptible varieties in field evaluation: A) Hybrid 2; B) Hybrid 7, showing no visible symptoms of bunchy top; and C-D Severe bunchy top with upright, crowded leaves at the shoot apex of follower plant of Inosa and Tinawagan Pula, respectively.

The visual assessment was confirmed by molecular virus detection using PCR analysis as presented in Figure 6. The results of PCR amplification for the detection of Banana Bunchy Top Virus (BBTV) in abaca varieties: Hbrid 2, Hybrid 7, Inosa, and Tinawgang Pula.The BBTV – specific prmer pair BBT-1/BBT-2 successfully amplified a 349bp fragment from the DNA of infected plants, while the AGM1025/AGM1026 primer pair served as an internal control by amplifying a 248bp fragment of *Musa* DNA.Results revealed that both Hybrid 2 and Hybrid 7 showed no amplification at the 349bp region, indicating the absence of BBTV in all field-collected samples. This outcome corroborates the findings of Ramos and Villanueva (2022), reported that specific abaca hybrids and breeding lines showed no BBTV -specific band amplification at 349bp using BBT-1/BBT-2 primers, suggesting molecular resistance or immunity to BBTV infection under natural field conditions. The presence of 248 bp internal control band in all lanes confirmed that DNA extraction and PCR were successful, validating the negative BBTV results in these hybrids. This approach aligns with recent studies emphasizing the critical role of internal controls in virus diagnostics to ensure the accuracy of negative findings (Ramos & Villanueva,2022; Sison &Aquino,2023; Delos Reyes and Mendoza,2020).

In contrast, “Inosa” and “Tinawagang Pula” showed strong amplification at the 349bp region across all tested samples, indicating a high incidence of BBTV infection. The primer pair, AGMI 025 and AGMI 026 designed to amplify the *Musa* sequence (Lagoda et al. 1998) with an expected product size of 248 bp, was used as an internal control.These molecular findings are consistent with previous studies reporting the susceptibility of traditional abaca varieties such as “Inosa” and “Tinawagang Pula” to BBTV, and further support the potential resistance of selected hybrids (Espino et al., 2020; Abad & Dela Cruz, 2021;PCAARRD,2019).

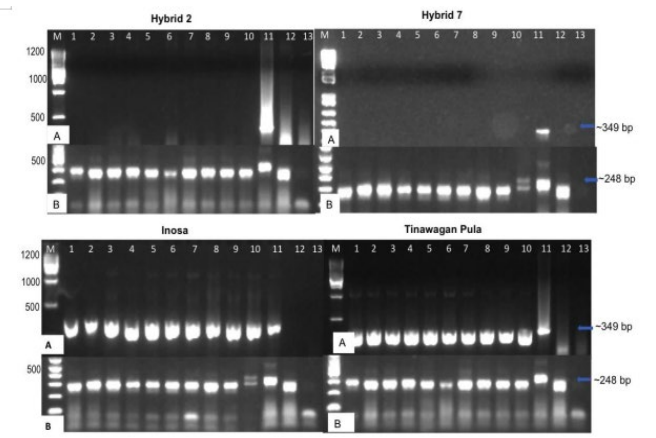

Figure 6. Banana bunchy top virus (BBTV) DNA-R fragment and *Musa* sequence amplified by polymerase chain reaction (PCR) using DNA template extracted from Abaca “Hybrid 2, 7, Inosa and Tinawagan Pula samples. A)- using the primer pair BBT-1/ BBT-2 (349 bp) and B)- AGM1025/AGM1026 (248 bp), respectively. Lane M:1Kb plus DNA ladder; Lane 1-10: Hybrid 2 field samples; Lane 11: healthy control; Lane 12: PCR negative control.

Additionally, abaca hybrids have shown some degree of resistance to bract and abaca mosaic, characterized by a low incidence of infection, as demonstrated under high disease pressure in screenhouse evaluations as shown in Figure 7.The 20% incidence of Sugarcane Mosaic Virus (SCMV) in Hybrids 2 and 7, with no detection of Banana Bract Mosaic Virus (BBrMV) or Cucumber Mosaic Virus (CMV), indicated partial resistance or virus-specific tolerance in these lines.However, the susceptible varieties of Inosa and Tinawagang Pula exhibited co-infection with multiple mosaic viruses reaching up to 20% for each pathogen, suggesting high vulnerability under field conditions. These findings are consistent with recent studies showing reduced mosaic virus incidence in abaca hybrids compared to traditional varieties (Sison & Aquino, 2023; Mendoza & Delos Reyes, 2022). In addition, the present result reinforces the outcomes of highlighting the partial resistance of abaca hybrids to mosaic viruses, especially their limited infection spectrum compared to native cultivars, which are more prone to co-infection and higher disease incidence (Florentino & Espino, 2020; David & Santos, 2021; Torres & Lumbres, 2023; Sison & Aquino, 2023; Mendoza & Delos Reyes, 2022).

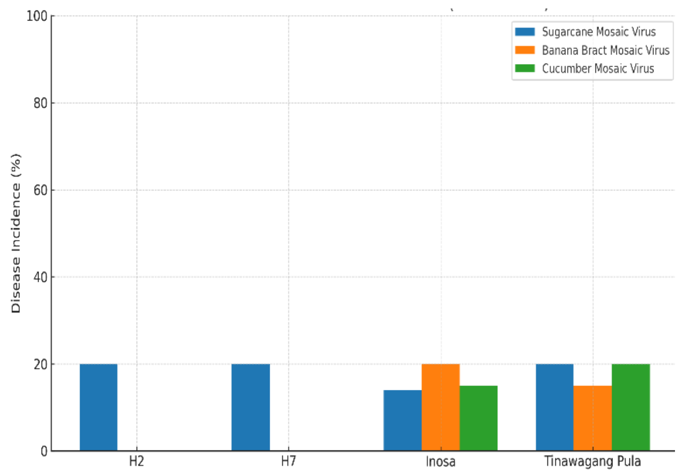

Figure 7. Incidence of mosaic diseases on abaca hybrids and susceptible varieties in field.

4. CONCLUSION

The study demonstrated that BTV-resistant abaca hybrids, particularly Bandala (H7) and Hybrid 2 (H2), exhibit superior agronomic performance and disease resistant compared to traditional varieties such as Inosa and Tinawagang Pula. Bandala (H7) showed significantly enhance vegetative traits including greater pseudostem length, girth, weight, and a higher number of suckers, highlighting its robustness and suitability for fiber production. On the other hand, Hybrid 2 demonstrated higher dry biomass accumulation and statistically significant fiber recovery rates, indicating its potential for maximizing fiber yield efficiency.

Moreover, no incidence of ABTV and other fungal diseases was observed in abaca hybrid plants, while the control varieties were infected with ABTV. All hybrid test plants were symptomless and tested negative for the presence of the virus through polymerase chain reaction (PCR) analysis using primers BBT1 and BBT2, which amplify the 349 bp fragment of the DNA-R viral genome component. In addition, abaca hybrids have shown some degree of resistance to bract and abaca mosaic, characterized by a low incidence of infection, as demonstrated under high disease pressure in the field. Regardless of the fertilizer applied, the agronomic characteristics (pseudostem weight, length and girth, number of suckers, fiber dry weight) of abaca hybrids are superior to those of the control variety.

These findings reinforce the potential of BTV-resistant abaca hybrids for commercial cultivation, offering a promising alternative to susceptible traditional varieties. The combined traits of enhanced growth, superior fiber yield, and a virus resistance position these hybrids as critical components in revitalizing the abaca industry through sustainable and resilient production systems. Further multi-site evaluations and economic analysis are recommended to support widespread adoption and assess long-term performance under diverse agro-ecological conditions.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to the Department of Science and Technology-Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (DOST-PCAARRD) for the generous support provided to this research. Their funding and assistance were instrumental in the successful implementation of the study.

We also extend our sincere appreciation to all individuals and institutions who provided guidance, technical assistance, and encouragement throughout the conduct of the study. Their support, in various forms, has been valuable in ensuring the success of this work. Finally, the authors thank their families, and colleagues for the patience, understanding, and continued moral support.

REFERENCES

Abad, R. G., & Dela Cruz, T. E. (2021). "Field screening of abaca cultivars for resistance to Abaca Bunchy Top Virus (ABTV)". Pp 17-25 in Journal of Plant Virology and Pathology, 25(1).

Bandala, N. M., & Aquino, V. M. (2021). "Comparative agronomic performance of abaca hybrids in different agro-climatic zones of the Philippines". Pp 55-64 in Journal of Crop Science and Biotechnology, 26(1).

Barbosa, C. F., Sevilla, R. T., Malabrigo, P. L., & Arevalo, J. R. (2023). "Abaca (*Musa textilis* Nee.): A fiber crop endemic to the Philippines". Industrial Crops and Products, 200, 116763.

Barcelon, J. M., & Dizon, T. O. (2019). "Performance evaluation of selected abaca hybrids in terms of growth, yield, and resistance to abaca bunchy top virus (ABTV)".Pp 147-156 in The Philippine Agricultural Scientist, 102(2).

David, E. R., & Santos, A. R. (2021). "Incidence and severity of mosaic diseases affecting abaca production in Eastern Visayas". Pp 107-115 in Journal of Plant Pathology and Biotechnology, *29*(3).

De la Peña, R. C., & Manila, A. C. (2011). "Selection and Evaluation of Abaca Hybrids with High Fiber Yield and Resistance to Bunchy Top Disease". Pp 45-50 in Journal of Agriculture and Food Technology, 1(4).

Delos Reyes, A. C., & Mendoza, L. S. (2020). "Molecular tools in virus indexing of abaca (*Musa textilis*) planting materials". Pp 22-30 in Philippine Journal of Virology, *12*(1).

Dizon, T. O., & Arevalo, J. R. (2014). "Field performance of selected abaca hybrids and traditional varieties in Eastern Visayas". Pp 15-25 in Annals of Tropical Research, 36(1).

DOST-PCAARRD. (2021). "Abaca S&T Program Terminal Report: Enhancing Abaca Fiber Industry through Hybridization and Field Evaluation". Department of Science and Technology – Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development.

Espino, R. R. C., Magnaye, L. V., & Aquino, V. M. (2020). "Detection of Banana Bunchy Top Virus in *Musa textilis* (abaca) using specific PCR primers". Pp 293-301 in The Philippine Agricultural Scientist, 103(3).

Florentino, M. A., & Espino, R. R. C. (2020). "Co-infection dynamics of Banana Bract Mosaic Virus and Sugarcane Mosaic Virus in *Musa textilis* under field conditions". Pp 18-27 in Philippine Journal of Virology, *10*(1).

Garcia, M. L., & Robles, A. D. (2024). "Comparative response of abaca hybrids and native cultivars to mosaic virus infections in Northern Mindanao". Pp 55-63 in Philippine Journal of Crop Protection, 50(1).

Hull, R. (2014). Plant Virology (5th ed.). Academic Press.

Kurien, R.A.,Selvaraj,D.P, Sekar, M.,Koshy,C.P.,Paul,C.,Palanisamy, S., Santulli, C., Kumar, P. (2023)." A comprehensive review on the mechanical, physical,and thermal properties of abaca fibre for their introduction into polymer composites". Springer Nature B.V.

Lagoda,P.J.L, Noyer J.L., Dambier, D., Baurens, F., Grapin, A., Lanaud, C. (1998). " Sequence tagged microsatellite (STMS) markers in the Musaceae. Pp 59-663 in the Mol Ecol 7(5).

Magnaye, L. V., & Espino, R. R. C. (2020). "Symptom expression and molecular detection of Abaca Bunchy Top Virus (ABTV) in selected Musa textilis varieties". Pp 302-209 in Philippine Agricultural Scientist, 103(3).

Mendoza, L. S., & Delos Reyes, A. C. (2022). "Molecular diagnosis and co-infection analysis of mosaic viruses in abaca growing areas". Pp 144-152 in Philippine Journal of Crop Science, 47(2).

Parac, E. P., Sta. Cruz, F. C., & Lalusin, A. G. (2021). "Resistance Reaction of Abaca (*Musa textilis* Nee) Hybrids to Bunchy Top and Establishment of Disease Severity Rating Scale for Screenhouse Screening". Pp 18-26 in Journal of Ecosystem Science and Eco-Governance, 3(2).

Parac, L. A., Medina, C. D., & Buenviaje, G. M. (2020). "Evaluation of abaca hybrids for resistance to bunchy top disease and yield performance". Pp 45-53 in Philippine Journal of Crop Science, 45(1).

Parac, E.P., Lalusin, A. G., Pangga, I.B.,Sta. Cruz, F.C. (2020). "Characteristics of Selected Hybrids of Abaca (*Musa textilis* Nee) with Resistance to Bunchy Top". Pp.1-16 in The Philippine Agricultural Scientist ,103 (1).

Parducho, V. A., Alipao, D. F., & Ramos, M. V. (2023). "Field performance and morphological evaluation of selected abaca (*Musa textilis* Nee) hybrids and traditional cultivars in varying agro-climatic conditions". Pp 18-25 in Philippine Council for Agriculture, Aquatic and Natural Resources Research and Development (PCAARRD) Technical Bulletin, 2023(2).

Patalinghug, J. S., Briones, N. D., & Valdez, E. C. (2020). "Growth performance and fiber yield of abaca (*Musa textilis* Nee) hybrids in different agro-climatic zones in the Philippines". Pp 18-26 in Philippine Journal of Crop Science, *45*(2).

PCAARRD. (2019). "*Abaca Industry Strategic S&T Program (ISP): Terminal Report*". DOST-PCAARRD.

Philippine Fiber Industry Development Authority (PhilFIDA). (2023). Annual Report on Fiber Crop Performance. Technical Bulletin No. 2023-04, Department of Agriculture.

Ramos, A. B., & Villanueva, L. R. (2022). "Detection efficiency of BBTV primers and resistance profiling in abaca breeding lines". Pp 112-120 in Philippine Journal of Crop Science, 47(1).

Ramos, H. C., & Peralta, J. P. (2018). "Fiber yield performance and recovery efficiency of selected abaca cultivars in Eastern Visayas, Philippines". Pp 33-38 in Asia Pacific Journal of Multidisciplinary Research, 6(3).

Ramos, J. D., & Estigoy, D. A. (2012). "Growth and yield performance of selected abaca (*Musa textilis* Nee) hybrids in Mindanao". Pp 389-397 in The Philippine Agricultural Scientist, 95(4).

Sastry, K. S., Mandal, B., Hammond, J., Scott, S. W., & Briddon, R. W. (2019). "*Musa textilis (Abaca)"*. Encyclopedia of Plant Viruses and Viroids. Springer.

Sharman,M., Thomas, J.E., & Dietzgen, R.G. (2000)."Development of a multiplex immunocapture PCR with colourimetric detection for viruses of banana". Pp 75-88 n the Journal of Virological Methods, 89 (1-2).

Sison, J. M., & Aquino, V. M. (2023). "Morphological and molecular indicators of ABTV infection in abaca". Pp 89-98 in International Journal of Tropical Agriculture, 61 (2).

Sison, M. L., Villegas, V. N., & de Vera, A. M. (2020). "Growth performance and fiber yield of selected abaca hybrids under field conditions". Pp 165-172 in The Philippine Agricultural Scientist, 103(2).

Thomson, K.G., & Dietzgen, R.G. (1995)."Detection of DNA and RNA plant viruses by PCR and RT-PCR using a rapid virus release protocol with tissue homogenization".Pp 85-95 in the Journal of Virological Methods, 54 (2-3).

Torres, J. M., & Lumbres, R. G. (2023). "Screening *Musa textilis* lines for resistance against three major mosaic viruses".Pp 65-74 in Asian Journal of Agricultural Research and Development, *12*(2).

Villamor, R. G., & Santos, D. R. (2018). "Incidence and severity of abaca viral diseases in traditional varieties in Eastern Mindanao". Pp 22-30 in Philippine Journal of Crop Science, 43(1).

Villegas, V. N., Sison, M. L., & de Vera, A. M. (2016). "Evaluation of abaca (*Musa textilis* Nee) hybrids for agronomic traits and fiber yield under field conditions". Pp 24-31 in The Philippine Journal of Crop Science, 41(2).