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RESEARCH ARTICLE

Isolation, identification and bioefficacy of indigenous entomopathogenic fungi against *Pentalonia nigronervosa* Coq. in Abaca

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ABSTRACT

Abaca (*Musa textilis* Nee) remains at risk due to Banana bunchy top virus and Abaca bunchy top virus, vectored by *Pentalonia nigronervosa* Coq. Present management practices primarily rely on chemical insecticides, raising environmental and sustainability concerns. This study explores the biocontrol potential of indigenous entomopathogenic fungi (EPF) sourced from aphids and rhizospheric soil in abaca-growing areas. Four fast-growing and sporulating ones were selected from twenty fungal isolates for molecular identification via the internal transcribed spacer (ITS) region. AEPF5 was 100 % similar to *Fusarium* sp., AEPF9 as *Penicillium* sp. (97 %), SEPF1 as *Talaromyces funiculosus* (100 %), and SEPF5 as *Trichoderma* sp. (99 %). SEPF5 and AEPF9 were the most aggressive and effective, with the highest mortality rates of 70.00 % and 64.44 % after 12 hrs, respectively. All isolates were comparable to the used commercial insecticide with 100 % mortality after 48 hrs. *Trichoderma* sp. showed rapid infectivity and robust pathogenicity. *Penicillium* sp. exhibited potent bioactivity but was marginally slower. Conversely, *Fusarium* sp. displayed limited pathogenicity, and *Talaromyces* sp. showed varied pathogenicity. Results affirm the promise of indigenous EPF as effective, reducing reliance on synthetic chemicals, improving ecological balance, and strengthening the resilience of abaca farming communities. This approach contributes to regenerative pest management strategies that align with sustainable fiber-based agroecosystems.

1. INTRODUCTION

Abaca (*Musa textilis* Nee), valued for its industrial-grade fibers, is a vital economic crop in the Philippines, supporting the textile industry and rural livelihoods. However, viral diseases such as Abaca Bunchy Top Virus (ABTV), Banana Bunchy Top Virus (BBTV), Banana Bract Mosaic Virus (BBrMV), and Sugarcane Mosaic Virus (SCMV) (Bajet & Magnaye, 2000) threaten its production. ABTV and BBTV, transmitted by the banana aphid *Pentalonia nigronervosa* (Coq.), are the leading causes of bunchy top disease, significantly reducing fiber yield and quality (Galvez et al., 2020). The aphid commonly infests the pseudostem, the youngest unfurled leaves, and the undersides of older leaves (Lalusin & Villavicencio, 2015).

A single banana aphid can acquire ABTV and BBTV from an infected plant within two hours of feeding, though higher aphid densities increase infection severity (Bajet & Magnaye, 2000). Infected abaca plants show stunted growth, undersized suckers, and narrow, stiff, up-curled leaves with chlorotic to necrotic margins, with symptoms like those of Banana Bunchy Top Disease (BBTD) in bananas (Magee, 1953).

Sucking pests are mainly managed with chemical insecticides; however, excessive and indiscriminate use has caused residue issues, environmental harm, pesticide resistance, and health risks (Pilkington et al., 2010; Pappas et al., 2013). Hence, there is a need for alternative biocontrol methods. Entomopathogenic fungi (EPF) produce cuticle-degrading enzymes such as protease, lipase, and chitinase, allowing them to penetrate the insect body and release mycotoxins that kill the host (Zakaria et al., 2018). These microbial pesticides offer an ecologically safe alternative to chemical insecticides due to their target specificity and are often used alone or integrated into pest management programs. Several EPF species, including *Lecanicillium lecanii*, *Beauveria bassiana*, and *Metarhizium anisopliae*, have shown strong biocontrol potential against aphids through

cuticle penetration, toxin production, and immune suppression. Laboratory bioassays have demonstrated up to 100% aphid mortality under optimal conditions (Qubbaj & Samara, 2022). Given their potential, this study utilizes indigenous EPF isolates from the abaca rhizosphere and banana aphid cadavers to explore sustainable strategies for managing *P. nigronervosa* and mitigating bunchy top diseases in abaca.

2. MATERIALS AND METHODS

2.1. Soil and Aphids Collection

The soil samples from the abaca rhizosphere and banana aphids from Surigao del Sur, Caraga Region, Philippines, were collected to isolate potential entomopathogenic fungi. The 127 dark-brown to blackish aphids were randomly collected through the gentle scraping technique using a miniature paint brush across five sites: 30 individuals from Farm 1, Brgy. Cabangahan, Tago (Site 1); 28 from Farm 2, Brgy. Cabangahan, Tago (Site 2); 34 from Brgy. Mahaba, Marihatag (Site 3); 20 from Farm 1 Brgy. Pungtod, San Agustin (Site 4); and 15 from Farm 2, Brgy. Pungtod, San Agustin (Site 5). These insect aphids were placed separately in UV-sterilized and ventilated plastic containers.

For soil sampling, three composite samples were collected per site, each consisting of five sub-samples taken from the abaca rhizosphere at a depth of 10–15 cm using a soil auger. Samples were stored in double Ziplock bags and, along with collected aphids, transported to the Molecular Biology and Agricultural Microbiology Laboratory (MolBAM) at Caraga State University for processing.

2.2. Fungal Isolation and Purification

To isolate fungi from aphids, samples were placed in UV-sterilized containers and incubated for 7–14 days to observe infection. Cadavers were surface sterilized with 70 % ethanol, rinsed with sterile distilled water, and incubated in Petri dishes with moist cotton at room temperature for 7 days to promote fungal growth. Emerging fungal colonies were then transferred to Potato Dextrose Agar (PDA), incubated for 5–10 days, and purified.

Composite samples per site were thoroughly mixed to isolate fungi from the soil. The 10 g from it was suspended in 90 mL of sterilized distilled water and serially diluted up to 10^{-5} following the protocol cited by Emmanuel & Igoche (2022). After homogenization, 100 µl aliquots were placed on PDA, spread uniformly using an L-shaped rod, then incubated for 2 to 4 days at room temperature (Goettel & Inglis, 1997). Fungal colonies were transferred to PDA for purification.

2.3. Morpho-Cultural Characterization of EPF

We placed a 5 mm agar disc from each potential EPF at the center of PDA plates and incubated them at room temperature for seven days. Cultural characteristics were recorded, including colony size, pigmentation, shape, elevation, margin, zonation, and texture. At the same time, morphological characterization includes the presence and absence of spores, spore size, and shape from the 50 randomly selected spores per isolate, stained with blue lactophenol, and examined under a compound microscope.

2.4. Molecular Characterization of EPF

Four fast-growing, spore-forming fungi were prepared following the company's sequencing guidelines. Agar blocks of each isolate were placed in 2 mL sterilized microcentrifuge tubes containing sterile distilled water and sent to Macrogen Inc. (South Korea) for DNA extraction and sequencing. The ITS region of the rDNA was sequenced using primers ITS4 (TCC TCC GCT TAT TGA TAT GC) and ITS5 (GGA AGT AAA AGT CGT AAC AAG G), and forward and reverse reads were analyzed using BioEdit v7.2.5 (Hall, 1999). Performed sequence identification with the highest similarity to known species through BLASTn (Altschul et al., 1990). Followed by multiple sequence alignment using Clustal W in MEGA v11.0.13 (Kumar et al., 2016). A best-fit model was applied, and phylogenetic relationships were constructed using the Maximum Likelihood method with initial tree construction via Neighbor-Joining and supported by 1,000 bootstrap replicates.

2.5. Rearing of *Pentalonia nigronervosa*

Banana aphids collected from Brgy. Basag, Butuan City, were introduced to 2–3-month-old abaca plants inside insect-proof cages. The 25–30 ˚C temperature providing around 50–65 % RH was regularly monitored to maintain optimal microclimatic conditions necessary for successful rearing (Pertiwi et al., 2022). After two generations, we established stable aphid populations suitable for bioassays. Rearing served as the source of healthy, uninfected experimental insects.

2.6. Applications of EPF

The 7-day-old cultures of AEPF5 - *Fusarium* sp., AEPF9 - *Penicillium rolfsii*, SEPF1 - *Talaromyces funiculosus*, and SEPF5 - *Trichoderma* sp. were used to prepare spore suspensions. We added sterile distilled water to each plate, and spores were gently scraped and filtered through sterile gauze into test tubes. Suspensions were adjusted to 1×10^6 spores/mL and mixed with 0.06 µL of 0.01 % Tween 80 to improve dispersion (Mwamburi et al., 2015).

UV-sterilized plastic containers with mesh-ventilated lids contained 15 aphids (adults and nymphs) and abaca leaf discs (~8 mm, Inusa variety) as a food source. Treatments included 400 µL of each fungal spore suspension, sterile distilled water (negative control), and a recommended rate of commercial insecticide (positive control). All treatments were applied to the prepared insects inside a container using a fine mist sprayer. The setup was maintained for 48 hours at room temperature (~65 % RH) in the MolBAM. Each treatment had three replicates, and trials were repeated thrice for statistical validity (Robson et al., 2007).

2.7. Analysis Following Death

Insect cadavers were transferred to sterile Petri plates for post-mortem analysis to assess fungal infection. Samples were examined under a stereomicroscope (LW Scientific) with 40x magnification for visible mycelial growth. Cadavers with fungal growth were directly placed on PDA and incubated at room temperature for 7 days. The presence of fungal hyphae or spores on the cadaver surface confirmed active infection, allowing reliable isolation by placing the cadaver on growing media to promote sporulation. This method minimizes the loss of viable fungal material during washing and is widely used in entomopathogenic fungal bioassays (Sharma et al., 2020). It involves transferring a fungal agar block from the colony edge of a dead cadaver to a fresh plate of PDA to assess the entomopathogenic potential through cultural and morphological traits.

2.8. Experimental Design and Data Analysis

Bioassays and fungal characterizations followed a Completely Randomized Design (CRD) with three replications per treatment across three trials. ANOVA with Tukey's Honest Significant Difference Test applied for post hoc comparison of treatment means for aphid mortality, fungal growth, and conidial size.

3. RESULT AND DISCUSSION

3.1. Indigenous Potential Entomopathogenic Fungi Obtained from Aphids and Soil

The number of fungal isolates varied depending on the source material and collection site. A total of 10 potential entomopathogenic fungi were isolated from *P. nigronervosa* cadavers: one isolate each from Sites 1 to 4, and six isolates from Site 5 (Table 1). Scorsetti et al. (2006) reported that fungal growth observed on aphid cadavers has effectively induced mortality across various aphid species, suggesting that naturally occurring fungi on aphid bodies may serve as viable entomopathogenic agents.

From soil samples, the study recovered a total of 10 isolates, three from Site 1, Site 2 (2), Site 3 (4), Site 4 (1), but none from Site 5. Fungi from the rhizosphere have been shown to possess biocontrol potential against various insect pests. Notably, well-established entomopathogenic genera such as *Metarhizium* and *Beauveria* have been isolated from rhizospheric soils, highlighting their efficacy in pest control (Nelly et al., 2019). The fungi isolated from this study's abaca rhizosphere may offer promising potential as biological control agents against banana aphids.

Table 1: Isolated indigenous EPF from aphids and abaca rhizosphere in Surigao del Sur, grown in PDA incubated for 7 days at room temperature.

Site	Place of Collection	Isolates from Aphids	Isolates from Soil
Site 1	Brgy. Cabangahan, Tago (Farm 1)	AEPF1	SEPF1, SEPF2 SEPF3
Site 2	Brgy. Cabangahan, Tago, Surigao del Sur (Farm 2)	AEPF2	SEPF4 SEPF5
Site 3	Brgy. Mahaba, Marihatag, Surigao del Sur	AEPF3	SEPF6 SEPF7 SEPF8 SEPF9
Site 4	Brgy. Pungtod, San Agustin, Surigao del Sur (Farm 1)	AEPF4	SEPF10
Site 5	Brgy. Pungtod, San Agustin, Surigao del Sur (Farm 2)	AEPF5 AEPF6 AEPF7 AEPF8 AEPF9 AEPF10	
	Total Isolates	10	10

3.2. Colony Growth and Sporulation Ability of EPF

Among the isolates, SEPF5 showed the fastest colony growth with a mean diameter of 90.00 mm, followed by SEPF2 at 81.60 mm, indicating similar rapid growth. Other promising isolates included SEPF9, AEPF2, and SEPF4 (71.40–73.70 mm). Moderate growth was observed in SEPF8 (63.80 mm) and AEPF5 (59.30 mm), while AEPF9 and SEPF6 shared equal growth at 55.50 mm. AEPF3 and AEPF4 had similar rates (48.90 mm and 49.20 mm), followed by AEPF10 (45.30 mm), AEPF6 (39.80 mm), and AEPF7 (41.30 mm): AEPF8 (38.40 mm) and SEPF7 (37.10 mm). SEPF1 (27.40 mm), AEPF1 (24.00 mm), and SEPF10 (24.10 mm) showed slower growth, while SEPF3 was the slowest at 18.20 mm.

Spore production was observed in only half of the isolates, six from aphids and four from soil, with varying conidial sizes. Sporulation is vital to the lifecycle and pathogenicity of EPF, enhances survival under harsh conditions, enables soil persistence, and aids in dispersal through air or host contact. EPF initiates infection by adhering to the insect cuticle, germinating, and penetrating the host. These traits highlight the essential role of sporulation in the fungi's effectiveness as biocontrol agents (Da Silva Santos et

al., 2019; Mantzoukas et al., 2022).

Based on colony growth and sporulation, four fast-growing, spore-producing fungi selected for further identification were AEPF5 and AEPF9 from aphid cadavers, and SEPF1 and SEPF5 from soil. Their rapid growth and reproductive capacity suggest strong potential as biocontrol agents against banana aphids.

Table 2. Colony diameter and conidial sizes of potential EPF from Surigao del Sur grown in PDA incubated for 7 days at room temperature.

Isolate code	Mean Colony Diameter (mm)	Conidial Size (µm)
AEPF1	24.00 hi	0.00
AEPF2	72.80 abc	0.00
AEPF3	48.90 def	0.00
AEPF4	49.20 def	0.00
AEPF5	59.30 cde	15.91
AEPF6	39.80 efgh	13.25
AEPF7	41.30 efgh	13.88
AEPF8	38.40 efghi	7.83
AEPF9	55.50 cdef	6.91
AEPF10	45.30 defg	11.22
SEPF1	27.40 ghi	4.82
SEPF2	81.60 ab	0.00
SEPF3	18.20 i	6.07
SEPF4	71.40 abc	0.00
SEPF5	90.00 a	6.57
SEPF6	55.50 cdef	0.00
SEPF7	37.10 fghi	0.00
SEPF8	63.80 bcd	0.00
SEPF9	73.70 abc	0.00
SEPF10	24.10 hi	6.07
P-value	0.0000	
CV	17.92%	

*Means with the same letter are not significantly different using the comparison of means by Tukey's HSD at a 5% significance level.

3.3. Molecular Identification of Selected EPF

The consensus sequence of each isolate obtained using the ITS4 and ITS5 primers was crucial in identifying isolates. Based on BLAST results, SEPF1 was identified as *Talaromyces funiculosus* (100 %), and SEPF5 is closely related to *Trichoderma harzianum* and *T. lixii* (99 %). In comparison, AEPF5 is 99 % related to *Fusarium* sp., suggesting that the ITS region is insufficient to determine up to the species level due to closely related species of the genus. ITS region was utilized in the experiment as the initial means of identification or delineation due to its commonness to mycological research, wide availability of ITS sequences of various species, fast evolving and highly conserved within species but variable between species (Hyde et al., 2014; Abdel-Mawgood, 2012; Esh, 2014). However, consistent with the findings of Hyde et al. (2014), ITS alone may not always provide sufficient resolution at the species level, particularly among closely related species. Meanwhile, the AEPF9 is 97 % related to *Penicillium rolfsii.*

The result was supported by the phylogenetic tree, suggesting that the four isolates differed at the genus level due to the clustering of clades (Figure 1). Isolate SEPF1 clusters with *T. funiculosus* CBS 884.70 and CBS 883.70 with 86 % bootstrap support; the clustering supports the hypothesis that SEPF1 belongs to or is closely related to the *T. funiculosus* species complex. Isolate AEPF9 clusters particularly with *Penicillium rolfsii* CBS 368.48 (86 % support), suggesting that the isolate is closely related to or may belong to *P. rolfsii.* Isolate SEPF5 clusters tightly with *Trichoderma harzianum* 42315bDRJ and CIB T44 and *T. lixii* NTOU and CY216 (91 % support), suggesting that SEPF5 likely belongs to the *Trichoderma,* a group known for biocontrol activity; meanwhile, AEPF5 clusters with various *Fusarium* species with 84% bootstrap support.

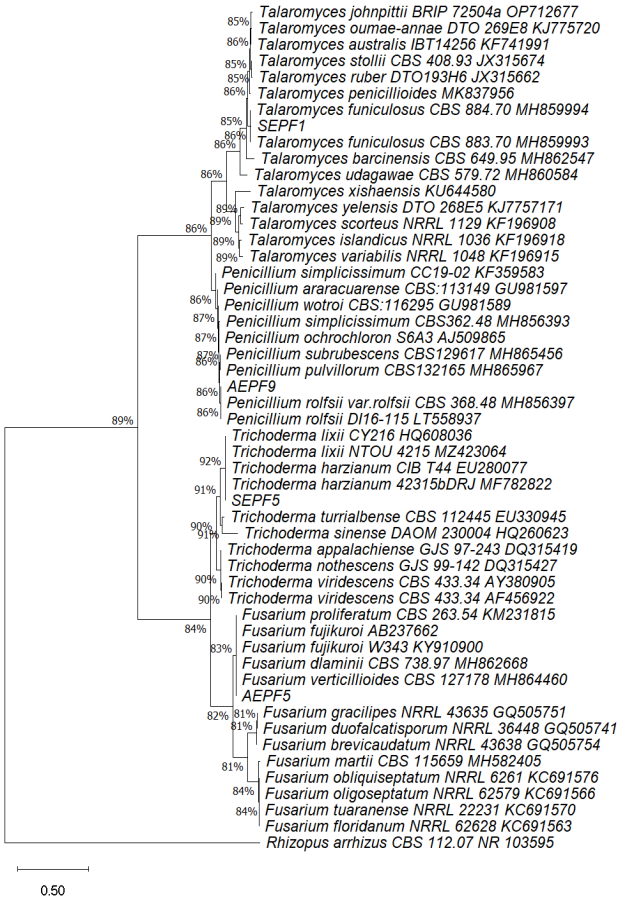

Figure 1: Maximum likelihood phylogenetic tree constructed based on the lowest Bayesian Information Criterion (BIC) score generated from the ITS region of fungal isolates, gaps treated as missing data with 1,000 bootstrap replications using K2: Kimura 2-parameter with Gamma Distribution. *Rhizopus arrhizus* (NR 103595) served as the outgroup taxon.

3.4. Aphid Mortality Count

The most aggressive in killing the banana aphid was observed in AEPF9 *Penicillium* sp. (T4) and SEPF5

Trichoderma sp. (T6) with 64.44% and 70.00 % mortality rate, respectively, but was not statistically comparable to the commercial insecticide with a 100% mortality rate at 12 hours (Table 3). The isolates T4 and T6 were significantly comparable to the commercial insecticide at 24 hours.

Based on the 48-hour mortality data, the most effective treatments were the positive control (T1), *Penicillium* sp. (T4), *Trichoderma* sp. (T6), and *Fusarium* sp. (T3), all achieving 100 % aphid mortality and showing no significant differences among them. The *T. harzianum* is effective against sugarcane woolly aphids (*Ceratovacuna lanigera*) and Russian wheat aphids (*Diuraphis noxia*), leading to their death (Islam et al., 2021; Rahim & Iqbal, 2019). Similarly, *T. lixii* causes mortality and reduces the survival of adult pea leaf miners (*Liriomyza huidobrensis*) and the emergence of adult progeny (Akutse et al., 2013).

Fusarium is reported to be effective in controlling insect pests. These fungi exhibit promising characteristics, such as causing a high mortality rate, acting quickly, and producing abundant spores (Da Silva Santos et al., 2019). *F. proliferatum* infects and causes high mortality in sap-sacking insect (*Thaumastocoris peregrinus*) and Rice flour beetle (*Tribolium confusum*). In contrast, *F. fujikuroi* infects yellow mealworm (*Tenebrio molitor*), greater wax moth (*Galleria mellonella*) (Sharma & Marques, 2018). On the other hand, *Penicillium* has insecticidal activity against insects, like against postharvest insects (*Tribolium castaneum*) (Al-Keridis, 2015), and against fall armyworm (Sharma et al., 2023).

Talaromyces funiculosus (T5) also exhibited high efficacy, with 95.55 % mortality, and was statistically comparable to the top-performing treatments. According to Nicoletti & Becchimanzi (2021), *T. funiculosus* has demonstrated the ability to kill second instar larvae of mosquitoes (*Aedes aegypti*), exhibit aphicidal activity against green peach aphids (*Myzus persicae*), show ovicidal activity against Colorado potato beetles (*Leptinotarsa decemlineata*), and kill adult milkweed bugs (*Oncopeltus fasciatus*). Although *Fusarium* sp. (T3) reached 100 % mortality at 48 hours, its earlier performance was comparatively less effective than T4 and T6.

As expected, the negative control (T2) consistently recorded the lowest mortality rates at all observation periods, reinforcing the validity of the bioassay and presence of active fungal agents. Overall, the results demonstrate that *Penicillium* sp. (T4) and *Trichoderma* sp. (T6) are the most reliable fungal treatments for aphid control, consistently matching the efficacy of the positive control across multiple time points.

Table 3: Mean mortality rate of *P. nigronervosa* treated with EPF after 12, 24, and 48 hours incubated at room temperature in all trials.

Treatment	Mean Mortality Rate (%)		
	12 hours	24 hours	48 hours
T1-Positive Control	100.00 a	100.00 a	100.00 a
T2-Negative Control	10.05 d	30.00 d	60.00 b
T3-AEPF5 *Fusarium* sp.	47.77 c	84.44 b	100.00 a
T4-AEPF9 Penicillium sp.	64.44 b	88.89 ab	100.00a
T5-SEPF1 *T.* funiculosus	37.77 c	65.55 c	95.55 a
T6-SEPF5 *Trichoderma* sp.	70.00 b	91.11 ab	100.00 a
P-value	0.0000	0.0000	0.0000
CV	11.40	10.33	4.31

*Means with the same letter are not significantly different using the comparison of means by Tukey's HSD at a 5% significance level.

3.5. Post-mortem Analysis

Post-mortem examination revealed fungal colonization and sporulation on aphid cadavers after several days of incubation across all three trials. Results confirmed the entomopathogenic potential of the four fungal isolates against banana aphids. Such post-mortem analysis is critical in EPF bioassays, as it provides direct visual confirmation of infection and allows comparison of isolate virulence (Qubbaj & Samara, 2022).

Each isolate exhibited distinct patterns of fungal development. In AEPF5 (*Fusarium* sp.), the aphid cadavers were almost completely enveloped by dense, dark fungal mycelia emerging from the insect body, indicating extensive colonization (Figure 2). AEPF9 (*P. roflsii*) caused severe rupturing of aphid bodies and extensive external mycelial growth, creating an explosion-like appearance almost completely obscuring the insect's original form. In SEPF1 (*T. funiculosus*), fungal growth manifested as thread-like structures emerging from collapsed aphid bodies, representing a distinct infection pattern. Meanwhile, SEPF5 (*Trichoderma* sp.) induced heavy fungal colonization, with aphid cadavers almost entirely covered by thick mats of dark mycelia, suggesting robust internal infection and successful fungal emergence.

These morphological differences reflect varying degrees of virulence, infection mechanisms, and colonization strategies among the isolates. The observed mycelial development, particularly the dense growth, validates the fungi's invasive capabilities and ability to penetrate and proliferate within the aphid exoskeleton.

Overall, the diversity in post-mortem infection characteristics underscores the value of thorough morphological examination in confirming entomopathogenicity, understanding host-pathogen

interactions, and identifying the most promising candidates for biological control of aphid pests (Qubbaj & Samara, 2022).

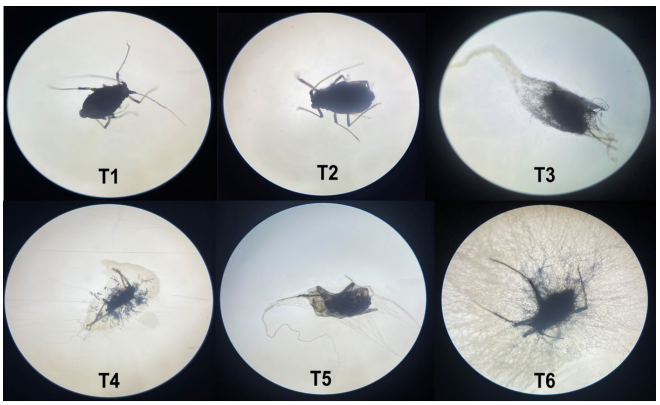

Figure 2: Fungal colonization in aphid cadavers under a stereomicroscope. T1-positive control, T2-negative control, T3-AEPF5 (*Fusarium* sp.), T4-AEPF9 (*Penicillium sp.*), T5-SEPF1 (*T. funiculosus*), T6-SEPF5 (*Trichoderma* sp.) (Magnification = 40x).

3.6. Morpho-Cultural Characterization of EPF Across All Trials

Fungal isolates were examined before and after the bioassay to establish their identity and confirm their infectivity through morpho-cultural characteristics. Four indigenous entomopathogenic fungi had distinct colony features. AEPF5 (*Fusarium* sp.) exhibited a woolly, filamentous, and raised colony texture, appearing filiform without zonation. The obverse side was white to pink or light pink, while the reverse showed cream white to light pink pigmentation (Figure 3). The result is consistent with findings by Harish et al. (2023), who reported variation in colony coloration among *Fusarium* isolates, ranging from violet, light violet, pink, and dirty white, with 47 isolates presenting white to dirty white hues.

AEPF9 (*Penicillium* sp.) formed colonies with a granular, filamentous, flat, and filiform appearance, lacking zonation. The obverse coloration ranged from grayish white to old green, light yellow, and shaded green, with the reverse side showing similar pigmentation. These characteristics align with the study by the University of Adelaide (2022), which described *Penicillium* colonies as creamy white to bluish green or light green aerially, and yellow to brownish yellow on the reverse.

SEPF1 (*T. funiculosus*) produced circular, raised, and woolly colonies without zonation. The obverse displayed white to pale gray pigmentation, while the reverse ranged from cream to pale yellow. *Talaromyces* spp. colonies are typically gray-green with white margins. Microscopically, the conidiophores are branched, with metulae and phialides extending from the branches, and the conidia are globose to subglobose (Liu et al., 2021). Meanwhile, SEPF5 (*Trichoderma* sp.) developed fast-growing colonies with a cottony and granular texture, filamentous and raised with a filiform appearance, and lacking zonation. The obverse color ranged from white to light green, while the reverse displayed white to old white pigmentation. These features align with those commonly reported for *Trichoderma* species (Gezgin et al., 2023).

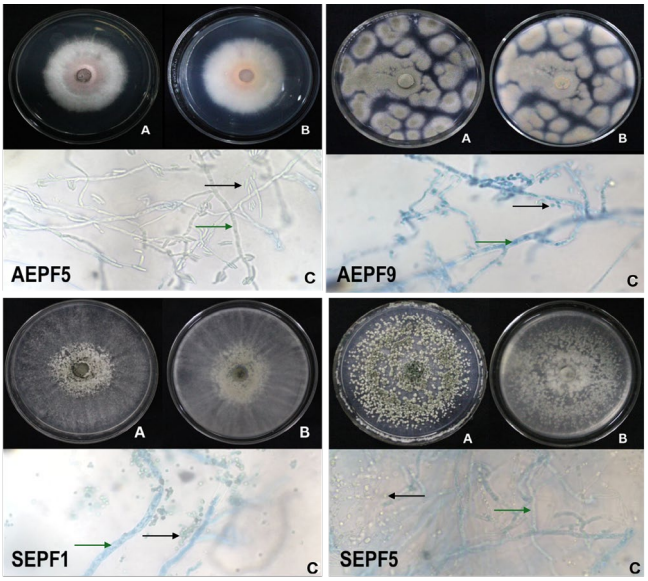

Figure 3: Morpho-cultural characteristics of entomopathogenic fungi. (A) Obverse view of fungal colony: (B) Reverse view of the fungal colony: (C) Hyphae and conidia under the light microscope. (Magnification = 400x; Green arrow = Hyphae; Black arrow = spores).

4. CONCLUSION

In conclusion, a total of 20 potential EPF were isolated from five different sites in Surigao del Sur; 10 were spore-forming fungi, of which six were from aphids and four were from soil. We subjected four isolates from the group to molecular identification based on their spore-forming characteristics and rapid growth observed during morpho-cultural characterization. The selected isolates include AEPF5 and AEPF9 from aphids, while SEPF1 and SEPF5 from soil. Based on the ITS sequences, AEPF5 was 100 % similar to *Fusarium* sp., with a bootstrap support of 84 %, AEPF9 as *Penicillium* sp. (97 % similarity with a bootstrap support of 86 %), SEPF1 as *T. funiculosus* (100 % similarity with a bootstrap support of 86 %), and SEPF5 as *Trichoderma* sp. (99% similarity with a bootstrap support of 91%). The study's results show strong evidence for the effectiveness of the four potential EPF as biocontrol agents against the banana aphid based on the percent mortality at the 48-hour observation period. The fungal isolates AEPF9 and SEPF5 were remarkable since they invariably did much better than the others and were highly promising for possible practical application in pest management.

Post-mortem examination showed fungal colonization and sporulation on aphid cadavers, confirming

their infectivity and pathogenicity. The fungal isolates were also thoroughly characterized to understand better their growth patterns, spore formation, and consistency of infectivity Results showed consistency in the characteristics, thus establishing the infectivity of all EPF tested. These findings benefit future research on growing these fungi in large quantities for application in agriculture. The results are particularly significant as they demonstrate a viable alternative to chemical pesticides, offering a more sustainable and environmentally friendly approach to pest management in abaca production.

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