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Evaluation of Biopesticide (Urtica spp.) Against Insect Pests and Diseases of Sweet Potato for Food Security

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ABSTRACT

Background: The sweetpotato weevil and sweetpotato virus disease (SPVD) are major biotic constraints that completely devastate sweetpotato fields and cause 50 – 100 % yield losses. Management includes cultural practices, tolerant varieties, chemical pesticides and integrated management strategies. Botanicals are gaining popularity in Integrated Pest and Disease Management strategies. Their insecticidal and fungicidal activities, biodegradability and safety increase their probability as alternatives to chemical pesticides. Urtica spp. are known for their insecticidal properties, but their efficacy in the management of the sweetpotato weevil and SPVD has not been documented.
Objective: A field trial was conducted to assess the efficacy of Urtica spp. (Adamfo Pa) against sweetpotato pests and diseases in the forest and savannah transition agroecological zones of Ghana in 2025.
Method: A Split-plot design with three replications was used. Three different rates of the extract, reference fungicide (Mancozeb WP) and biopesticide (Bypel), plus a control, were tested on Cylas sp. and SPVD susceptible sweetpotato variety.
Results: No disease incidence was recorded. The test product at the application rate of 500 ml/100 L of water per week was effective in reducing pest infestation and damage on the leaves and storage roots. It was also found to be efficacious in minimising sweetpotato storage root damage and increasing yield.
Conclusion: The study confirms that Urtica sp. extracts exhibit insecticidal and fungicidal properties that act as insect repellents or growth inhibitors. It is certified for use on carrots, beans, potatoes and strawberries, and recently extended to sweetpotatoes due to the outcome of this study.

KEYWORDS: Biopesticide, Cylas sp, Food security, Sweetpotato, Urtica spp.

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1.0 INTRODUCTION

Sweetpotato (Ipomoea batatas (L) Lam) is a highly versatile staple root and tuber crop belonging to the botanical family Convolvulaceae (Thottapilly, 2009). It is the sixth most important staple food globally after rice, wheat, potato, maize, and cassava (CIP, 2020).

Sweetpotato is well recognised as a food and income security crop in low-income developing countries (Tigabu et al., 2015). Its drought resilience (Alemu et al., 2025) also makes it a vital asset in food systems resilience for improved food and income security in many developing countries.

Globally, the productivity of sweetpotato may be reduced due to insect pests and diseases (Ochieng et al., 2017; FAO, 2013). Exploitation of the crop's full potential as a food and income security staple crop in Ghana has been bedevilled by the sweetpotato weevil (Cylas puncticollis) and the sweetpotato virus disease (SPVD), causing a reduction in productivity and market value. The most serious and commonly reported insect pests for sweetpotato in Africa are caterpillars of the sweetpotato butterfly (Acraea acerata Hew., Nymphalidae), the sweetpotato weevils (Cylas brunneus F. and Cylas puncticollis Boheman), the clearwing moth (Synanthedon spp.), the sweetpotato hornworm (Agrius convolvuli L.) and vectors of SPVD, the whitefly (Bemisia tabaci) (Nderitu et al., 2009) and aphids. The sweetpotato weevil (Cylas sp.) is a major pest inflicting severe damage to sweetpotato vines and storage roots in the field and storage in Africa, Asia, and Central America (Seow Mun and Min-Yang, 2015; Kandori, et al, 2006). The two African Cylas spp. (C. puncticollis and C. brunneus) usually appear together in fields and cause huge yield losses of up to 100 % especially during dry periods (FAO, 2013). Yield loss from both the larvae and the adult is estimated at 22 – 70 % (Tarekegn et al., 2014b). Larval tunnelling in the storage roots results in the formation of trepan, emitting a bitter flavour (Kibrom, 2015; Akazawa and Uritani, 1960). This affects the aesthetic value, making the storage roots unwholesome for consumption and sale. It also feeds on the woody base of the stem (Kabi et al., 2001), reducing or obstructing the flow of water, minerals and assimilates in the xylem and phloem.

The SPVD is the most destructive disease of sweetpotato globally (Zhang et al., 2020). It is caused by the synergistic effect of aphid-transmitted sweetpotato feathery mottle virus (SPFVM) and whitefly-transmitted sweetpotato chlorotic stunt virus (SPCSV) (Barkessa et al., 2018; Karyeija et al., 2000). Symptoms of SPVD include stunted growth, vein clearing, leaf chlorosis, distortion, puckering, discolouration, and deformity (Gibson and Ritual 2002; Adikini et al., 2016).

Cultural practices and varietal resistance are the common practices used for the management of the sweetpotato weevil and SPVD in Ghana since production has largely been on a small scale. However, with the emerging commercial value of the crop as a remedy for public health challenges, and export diversification because of its biofortified nature, these practices need to be augmented to sustain its productivity and industry. The need for resorting to chemical remedies shall emerge with its anticipated effects and limitations such as, the destruction of natural enemies (Stathers et al., 2005, Carneiro et al., 2014; Anjali, 2020), and pollinators under natural circumstances.

Biopesticides are extracts from poisonous plants. Their active ingredients are the secondary metabolites - products of their metabolic pathways (Ren et al., 2020). They have a wider mode of action (Jaoko et al., 2020; Mao and Henderson, 2007), degrade rapidly, eco-friendly, target specific (Singh and Kaur, 2018; Kamaraj et al., 2018), and are considered better alternatives to chemical insecticides (Ren et al., 2020). Some successful studies on the use of biopesticides in the management of Cylas species conducted over the years include plants like Azadiracta indica (neem), Pachyrhizus erosus (yam bean), Nicotiana tabacum, Carica papaya, Chromolaena odorata and Moringa oleifera (Igwe et al., 2021; Prasad et al., 2022). Other plants like Ocimum, Capsicum, Lippia and Basil oils are also potential biopesticides that can be used (Kyereko et al., 2024; Keyser et al., 2024).

Sweetpotato weevil management trials in Ghana apart from chemical pesticides, mainly focused on the use of biopesticides like Ocimum, Capsicum, Lippia, Basil oils and Azadiracta indica (Kyereko et al., 2024;). Most of these trials apart from neem are still in the experimental stage and may work for small-holder farmers and homesteads. There is therefore the need to add on to the already proven neem formulations to increase the options of biopesticides for farmers with large acreage. Urtica spp. (Urtica dioica -stinging nettle and Urtica urens - dwarf nettle) are known for their insecticidal properties, but their efficacy in the management of the sweet potato weevil is not yet documented. This study sought to address a critical gap in current sweetpotato weevil and SPDV management in Ghana by assessing the efficacy of a ready-to use botanical extract Adamfo Pa (Urtica spp.15g/L) formulated by Naturnova company limited as a biopesticide and bio-fungicide. The aim was to promote sustainable and eco-friendly production of sweetpotatoes for higher productivity and enhanced market value for improved livelihood.

2.0 MATERIALS AND METHODS

2.1 Experimental Site

The work was carried out at the CSIR-CRI research stations at Fumesua in the Forest ecozone and Ejura in the Savannah -Transition ecozone of Ghana, which are hot-spots for the sweetpotato weevil and SPVD. Fumesua (6º45'00.58' N; 1º31'51.28' W) has Ferric Acrisol, Asuansi soil series16 (FAO, 1990), with greyish-brown sandy loam top soil and an effective depth of about 100 cm1 (Adjei-Gyapong and Asiamah, 2000). The soils are inherently low in fertility with limited moisture retention capacity. The average annual rainfall of 1550 mm is unevenly distributed with an annual temperature range of 21.1˚C to 32.7˚C, and an average of 31.6˚C. Ejura (7° 23' 8.088" N; -1° 21' 22.212 E) has Ferric Acrisols/Ferralsols soil, which is deep, well drained, and sandy loam to loam in texture (Buri et al., 2017). The annual rainfall is 1,200 - 1,500 mm, with annual temperature of 29–36 °C and mean annual temperature of 26.3 °C (Adu et at., 2021).

2.2 Plant material used

The sweetpotato variety CRI-Apomuden released by the CSIR-Crops Research Institute, Ghana in 2005 (NVRRC, 2019), was used as the test crop. It has a higher beta-carotene content (the precursor for vitamin A deficiency), higher sugar content, and higher storage root yield. It is excellent for baby foods and a good combination for dairy and bakery products. It is susceptible to the Cylas spp. and SPVD. Planting materials used were vines sourced from the Sweetpotato Improvement Programme of CSIR-CRI, Fumesua.

2.3 Biopesticide extract used

Urtica (Adamfo Pa), a biopesticide extract product derived from Urtica dioica and Urtica urens developed by Naturnova was used. A standard fungicide Mancozeb WP (Manganese and Zinc) biopesticide Bypel (active ingredients: Pieris rapae, Granulosis Virus (10000PIB/mg and Bacillus thuringiensis 16000IU/mg.) were used as a check in the assessment of the efficacy of Adamfo Pa.

2.4 Land preparation and Crop establishment

The fields were mechanically prepared (ploughing, harrowing, and ridging) using a tractor. The planting arrangement was one row per ridge, with a distance of 1 m between ridges. The length of a ridge was 3.6 m, and within row planting space was 0.3 m, giving a total of 12 plants per ridge. Three-node vine cuttings of about 30 cm length were used for planting.

2.5 Experimental design, treatment application, and monitoring

The split-plot design was used for the evaluation of two key treatment factors: application interval and dosage rate. The main plot factor was the frequency of application, which had two levels (Weekly and Bi-weekly application). Within each main plot, five sub-plot treatments were applied, representing different rates of the biological extract, including a control and standard pesticide and fungicide used as references (Control at 0 ml/100 L of water; Adamfo Pa at 300 ml/100 L of water; Adamfo Pa at 400 ml/100 L of water; Adamfo Pa at 500 ml/100 L of water; Reference biopesticide (Bypel for insect pest control) and fungicide (Mancozeb WP for fungal control). Each treatment combination was replicated three times to ensure statistical robustness and reliability of the results. Additionally, one-meter alleys were established between plots to minimise chemical drift and cross-contamination between treatments. Pesticide application commenced, after crop establishment. Each plot received treatment based on its assigned frequency. Weekly plots received eight (8) applications, while bi-weekly plots received four (4) applications. The applications were done using a calibrated manually-operated knapsack sprayers equipped with a single nozzle. All activities were conducted under strict Good Agronomic Practices (GAPs), including regular weeding, pest scouting, observation for infections, and irrigation when necessary.

2.6 Data collection

Pest and disease incidence and severity were scored based on visual inspection of established plants conducted on a weekly basis, using a pest and disease severity scale (Table 1) adopted from standardised IPM monitoring practices (Sibiya & Sumbwanyambe, 2019; Mitra et al., 2022). Data on pest incidence were assessed from the number of infested plants per plot. Data on leaf damage severity was scored on a scale of 1-5 based on the degree of leaf damage. Similarly, weekly checks for symptoms such as leaf scorch, chlorosis, or plant stunting were also done. The target insect pests were sweetpotato weevil, whiteflies and aphids. The diseases assessed included leafspot, charcoal rot, Fusarium wilt and SPVD.

Table 1: Pest incidence and severity scale

Severity Scale	Description (extent of leaf damage)
1	No visible damage
2	Slightly chewed leaf patches (≤10 %)
3	Moderate leaf damage (≥10 - 25%)
4	Severe leaf damage (≥26 – 50 %)
5	Very severe leaf damage (total defoliation) ≥50 %

The number of infected plants, leaf area damage, damage on the basal part of the plant, and number of morphologically damaged storage roots were recorded using the standard scale presented in Table 2, adopted from Raman & Alleyne, (1991). Storage roots were observed for adult sweetpotato weevils. Storage root yield was also recorded. Regular checks for leaf burn and scorches due to phytotoxic effects on plants were also done.

Table 2: Stem basal portion and root damage scale

Damage Scale for basal portion and roots	Description
1	No damage/Healthy basal stem and roots
2	Slight damage/Small feeding holes (≤10 % basal stem tissue affected)
3	Moderate damage/Visible tunnelling (10 - 25% tissue affected)
4	Severe damage/Large tunnels with cracks (26-50% tissue affected)
5	Very severe damage (≥50 % basal stem tissue and roots destroyed

2.7 Data analysis

Data were analysed using Analysis of Variance (ANOVA) with the Genstat version 9.2.0.152 (Genstat, 2007). Before analysis, data were examined for normality and homogeneity of variances using the Shapiro–Wilk and Levene tests (Field, 2013). Count data were square-root ($\sqrt{x}$ +0.5) transformed, and the damage scores arcsine-transformed (Zar, 2010) to stabilise variance. Means were separated using Tukey's HSD at 5% probability. The data was further subjected to correlation analysis to assess the level of relation between the response variables.

3.0 RESULTS AND DISCUSSION

The contrasting environments employed in this study offered diverse climatic and soil conditions and enabled a comprehensive evaluation of Adamfo Pa across varied growing conditions. The factorial arrangement helped to isolate and assess the impact of both application frequency and dosage levels independently, as well as exploring their interactions and effects. The ANOVA showed significant effect for both application rate and dosage of Adamfo Pa on the plant health indicators of sweetpotato. These indicators include foliar damage, stem basal portion damage, morphologically damaged storage roots, biotic stress (pest and disease incidence and severity) and productivity (biomass and yield). No significant SPVD occurrence was observed at both trial locations. Hence, the assessment of the standard fungicide Mancozeb WP was suspended, as there is no valid basis for its comparative analysis. There were also no visible signs of phytotoxicity on the plants. Hence, the results presented are those observed for the sweetpotato weevil and other possible soil arthropods. As a result, the performance of the test product was compared with only the control and the standard biopesticide (Bypel).

3.1 Plant infestation (leaf damage and severity)

Tables 3 and 4 show the comparison of mean pest incidence and severity of defoliators at the vegetative stage of the sweetpotato crop at the two agroecological zones. There was a high pest (defoliators) incidence and severity on the untreated control plots. The application of Urtica Adamfo Pa progressively reduced the incidence and severity of defoliators, minimizing foliar damage significantly compared to the untreated control (Table 3). However, while the treatment effect at the three dosage levels on the number of infested plants were comparable to 205 the standard (Bypel) in the forest ecozone, it was the highest rate (500 ml/100 L) that was 206 statistically comparable to the standard (Bypel) in the transition ecozone (Table 3), indicating 207 the need for location specific recommended dose of the Adamfo Pa biopesticide. There was a 208 significant difference between the application intervals across locations with the weekly 209 application significantly reducing pest incidence.

Table 3: Mean number of plants infested per plot post-treatment

	Location	
Application dose	FUMESUA (Forest Ecozone)	EJURA (Savanah-transition Ecozone)
Control (0 ml/100 L of water)	23.03^{a}	6.29^{a}
Adamfo Pa at 300 ml/100 L of water	14.28^{b}	2.27^{b}
Adamfo Pa at 400 ml/100 L of water	11.33^{c}	2.06^{b}
Adamfo Pa at 500 ml/100 L of water	9.40^{cd}	2.10^{b}
Reference biopesticide (Bypel)	8.57^{d}	1.92^{b}
Application interval		
Weekly	2.47^{a}	2.70^{a}
Bi-weekly	2.63^{b}	3.34^{b}

Treatments designated with different letters indicate significant differences at $p \leq 0.05$

The assessment of severity revealed higher leaf damage in the untreated control plots (Fumesua: 4.78; Ejura: 4.00), which was significantly greater than the reduced damage observed in the treated plots. At Fumesua, no significant differences were detected among the various application levels of Urtica Adamfo Pa, and their performance was statistically comparable to the standard biopesticide (Bypel), while differing significantly from the control.

Notably, Urtica Adamfo Pa applied at 300–500 ml/100 L of water resulted in a significant reduction in leaf damage. At Ejura (transition ecozone), a significant difference was observed between the performance of low rate (300 ml/100 L of water) and the two other levels (400 ml/100 L of water and 500 ml/100 L of water) of the Urtica Adamfo Pa in minimizing the leaf damage. However, the latter two were not significantly different from the standard (Bypel).

Table 4: Mean severity of leaf damage (score, 1–5) per plot post-treatment

	Location	
Application dose	FUMESUA	EJURA
Control (0 ml/100 L of water)	4.78[a]	4.00[a]
***Adamfo Pa* at 300 ml/100 L of water**	2.10[b]	1.54[b]
***Adamfo Pa* at 400 ml/100 L of water**	2.00[b]	1.29[bc]
***Adamfo Pa* at 500 ml/100 L of water**	2.00[b]	1.13[c]
Reference biopesticide (Bypel)	1.87[b]	1.04[c]
Application interval		
Weekly	2.53[a]	1.95[a]
Bi-weekly	2.47[b]	1.65[b]

Treatments designated with different letters indicate significant differences at $p \leq 0.05$

The biweekly applications slightly surpassed weekly applications in reducing leaf damage severity, signifying that consistent but not excessive spraying may be optimal. The reduction in incidence and leaf damage severity with the Urtica Adamfo Pa biopesticide augments studies that proved that pest suppression with biopesticides reduce leaf damage severity (Chopra et al., 2025; IFDC, 2025; Perveen, 2024; Ratto et al., 2022).

The efficacy of the test product (Urtica Adamfo Pa) also impacted the biology of the vectors of SPVD, particularly aphids and whiteflies (Bemisia tabacci). The test product (Adamfo Pa) was efficacious in the management of aphids. No aphids were recorded at both trial locations. This confirms the reports from literature that Urtica spp. extracts repel aphids (Thapa et al., 2022). The absence of aphids and whiteflies explains the absence of the SPVD. This also verifies the efficacy of the antimicrobial properties of the active compounds in Urtica spp. in protecting plants against diseases (MDPI, 2023). Uğur et al. (2025) also confirmed its antimicrobial and cytotoxic potentials. Other studies have highlighted the antioxidant and antimicrobial properties of U. urens, suggesting potential applications in plant protection and integrated disease management (Maaroufi et al., 2017). Pillai et al. (2020) also reported that U. urens extracts show antibacterial and antifungal action, effectively deterring pathogens in agar diffusion assays. According to literature, merely intercropping U. dioica with other plants increases the resistance of the other plants to bacterial infections (Ghimire et al., 2022). The results from this study, coupled with evidence from earlier studies, confirm the effectiveness of the Urtica spp. Adamfo Pa biopesticide in inhibiting the pathogenic impact of SPVD.

3.2 Stem basal portion damage assessment

The basal portion of the sweetpotato vine is directly linked to the plant's vascular system and the primary rooting zone, containing nodes that are mostly active in root initiation. Damage of any form can weaken the plant and disrupt storage root formation. Damaged basal stems can serve as entry points for disease pathogens that can spread to the roots and the vines, resulting in severe yield losses (Essilfie et al., 2016; Pitiki et al., 2023). Table 5 shows the performance of Urtica Adamfo pa on the mean basal portion damage of the stems of the sweetpotato vines.

Table 5: Mean total basal portion damage (1 - 5) at different treatment levels and application intervals

	Location	
Application dose	FUMESUA	EJURA
Control (0 ml/100 L of water)	3.03[a]	2.03[a]
***Adamfo Pa* at 300 ml/100 L of water**	1.46[b]	1.57[b]
***Adamfo Pa* at 400 ml/100 L of water**	1.27[c]	1.18[c]
***Adamfo Pa* at 500 ml/100 L of water**	0.81[d]	0.71[d]
Reference biopesticide (Bypel)	0.30[d]	0.50[d]
Application interval		
Weekly	1.673[a]	1.200[a]
Bi-weekly	1.560[a]	1.200[a]

Treatments designated with different letters indicate significant differences at $p \leq 0.05$

The positive scores for the basal portion damage in Table 5 signify the presence or activity of sweetpotato weevils and/or other soil-borne arthropods. The control plots recorded the highest basal portion damage, confirming the severity of pest pressure in the absence of intervention. The application of Adamfo Pa resulted in a significant damage reduction in a dose-dependent manner across the treatment levels. The standard biopesticide (Bypel) recorded the lowest damage. There was no significant difference between the performance of the test product on the basal portion damage score at the two different application intervals for both locations. This suggests that dosage strongly influences basal portion protection better than frequency of application. Previous studies and reviews highlighted that biopesticide efficacy is strongly dose-dependent while frequency adjustment influence labour and cost efficiency (Kumar & Khurana 2025; Mawcha et al., 2024; Fenibo and Matambo, 2025). Damage levels were consistently higher at Fumesua across treatments, a clear scenario of site–specific pest pressure. Despite that, the relative performance of the treatments across both locations was consistent, re-enforcing the efficacy of both Urtica Adamfo Pa and Bypel in minimizing basal portion damage.

3.3 Morphologically damaged storage roots and yield response

The mean morphologically damaged storage roots presented in Table 6 shows clearly, high morphological damage in control plots across both locations. There was no significant difference in the level of morphological damage to the storage roots at the two different application intervals. The performance of the three dosage levels of the test product at both trial locations differed significantly from the standard biopesticide which showed no morphologically damaged storage roots. The performance of the standard reference (Bypel) was significantly different from the test product, and their effect in minimizing the damage levels of the storage roots was comparable across both trail locations.

Table 6: Mean morphologically damaged storage roots

	Location	
Application dose	FUMESUA	EJURA
Control (0 ml/100 L of water)	3.00^{a}	3.50^{a}
***Adamfo Pa* at 300 ml/100 L** of water	1.33^{b}	1.31^{b}
***Adamfo Pa* at 400 ml/100 L** of water	1.16^{b}	1.15^{b}
***Adamfo Pa* at 500 ml/100 L** of water	0.83^{b}	0.92^{b}
Reference biopesticide (Bypel)	0.00^{c}	0.00^{c}
Application interval		
Weekly	1.53^{a}	1.27^{a}
Bi-weekly	1.33^{a}	1.27^{a}

Treatments designated with different letters indicate significant differences at $p \leq 0.05$

The absence of significant differences between the two application intervals suggests that bi-weekly application might be sufficient, offering potential cost and labour efficiency without compromising pest suppression.

A physical examination of the storage roots did not reveal any sweetpotato weevils at both trial locations. The signs of damage observed on some storage roots could be associated with the activities of other soil arthropods.

In terms of storage root yield, control plots produced the lowest yield, highlighting the severe impact of pest pressure on untreated crops. Again, the application of Urtica Adamfo Pa improved productivity in a dose-dependent manner at both trial locations. At 300 ml/100L of water, productivity almost doubled compared to the control. Further increases were observed at 400 ml/100L of water and peaked at 500 ml/100 L of water. The overall highest productivity was achieved by the reference biopesticide Bypel, Conversely, no significant difference was observed between the high application rate (500 ml/100 L of water) of the test product and the standard (Bypel), except for number of storage root yield at Ejura. Bypel demonstrated superior efficacy but Urtica Adamfo pa at higher doses produced comparable performance.

This augments the work of Igwe et al. (2021), who concluded from their research that plant biopesticide extracts can be used to manage sweetpotato weevil and also enhance the yield of storage roots. Similarly, other studies have confirmed that, pest suppression through biopesticides and biological control translate into improved yield outcomes (Adero et al., 2024; Zhang & Landis, 2020).

Table 7: Effect of treatments on sweetpotato productivity.

	Number of storage roots/ha		Storage root yield (kg/ha)	
	FUMESUA	EJURA	FUMESUA	EJURA
Application Dose				
Control (0 ml/100 L of water)	14200^{d}	28400^{e}	8.9^{c}	12.2^{d}
Adamfo Pa at 300 ml/100 L of water	26400^{c}	52800^{d}	12.9^{c}	15.1^{c}
Adamfo Pa at 400 ml/100 L of water	29000^{bc}	58000^{c}	14.9^{b}	18.9^{b}
Adamfo Pa at 500 ml/100 L of water	33200^{a}	65733^{b}	16.5^{a}	22.0^{a}
Reference biopesticide (Bypel)	35400^{a}	70800^{a}	16.5^{a}	23.1^{a}
Application Interval				
Weekly	28640^{a}	57280^{a}	14254^{a}	19.3^{a}
Biweekly	26240^{b}	53013^{b}	13589^{a}	17.2^{b}

Treatments designated with different letters indicate significant differences at $p \leq 0.05$

The correlation matrix (Figure 1) displays the strength of interaction between yield, incidence and severity. The correlation analysis confirmed a strong negative correlation between infestation and yield (-0.93) and severity and yield (-0.95), whilst showing a strong positive correlation between infestation and severity (+0.97). It confirms that the presences of pests directly determine the level of leaf injury, augmenting the empirical evidence that pest and vectors weaken foliage and reduce the photosynthetic capacity of plants. The strong negative correlation of both infestation and severity with yield confirms that managing pests is critical for the maintenance of productivity as unchecked infestation leads to severe yield losses.

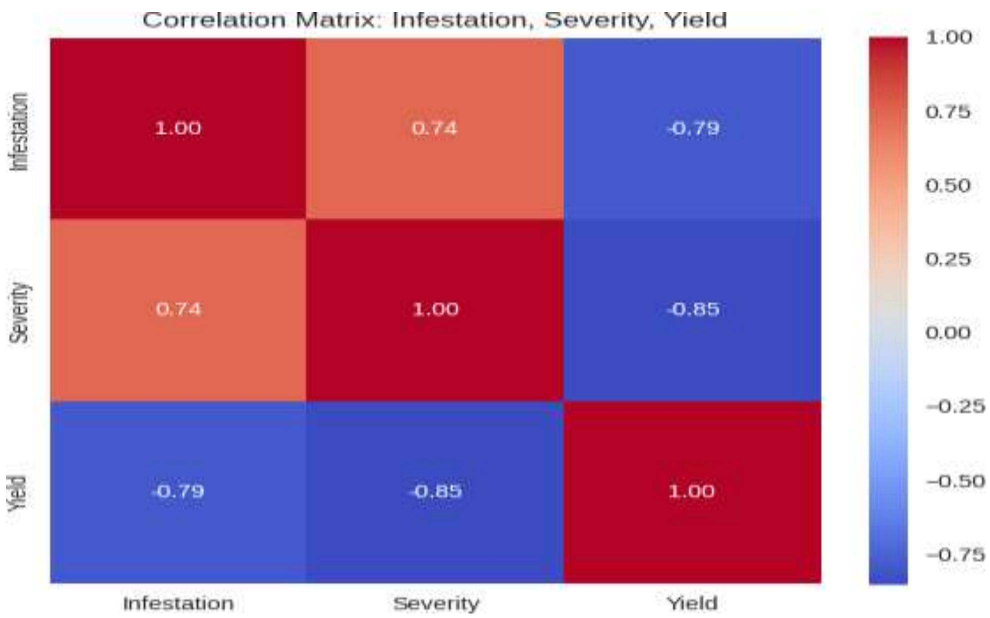

Figure 1: A Combined Pearsons correlation coefficients of incidence, severity and yield of sweetpotato

3.4 Implications for Integrated Pest Management (IPM) and Food Security

The active ingredient in the test product, Urtica Adamfo Pa is a combination of two Urtica spp. (Urtica dioica L. and Urtica urens L.). Urtica dioica, known as the stinging nettle is viewed as a neglected plant (Thapa et al., 2022) and Urtica urens is also known as the dwarf nettle. It is rich in phenolic compounds, flavonoids and formic acid that acts as insect deterrents (Sharma and Singh, 2020). These are known to act as insecticide repellents for aphids, beetles and caterpillars and are potent for the treatment of plant diseases due to their fungicidal properties (MDPI, 2023). Confirmation from studies show their bio-activity against several phytopathogenic fungi (MDPI, 2023). This study is the first of its kind in their application in the management of sweetpotato weevil and SPVD.

Studies of biopesticides like neem, Dennettia tripetala, Xylopia aethiopica, and Aframomum melegueta on Cylas sp. management in Ghana mostly on storage roots has proven positive7 (Nta and Oku, 2019; Asiedu and Aiyejagboyin, 2004). These formulations effectively reduced damage and infestation, signifying great potential for small-scale farmers (Keyser et al., 2024).

Urtica Adamfo Pa biopesticide demonstrated significant pest suppression and yield improvement across all parameters - incidence, leaf damage severity, basal portion damage, morphological storage root damage and productivity. The dose-response trend highlights the importance of higher application rates (400-500 ml/100L of water), which approaches the efficacy of the reference biopesticde Bypel. The consistent performance across sites and the minimal differences between weekly and by-weekly application intervals highlights the robustness and practical applicability of Urtica Adamfo Pa. The patterns of correlation align with the treatments data clearly demonstrating a dose-response consistency in reducing infestation and improve yields. This emphasizes the importance of optimum dosage over application frequency in Integrated Pest Management strategies.

These results reinforce the potential of biopesticides as sustainable alternatives to synthetic pesticides, aligning with integrated pest management (IPM) strategies. By reducing crop damage and enhancing productivity, Urtica Adamfo Pa offers a promising option for sweetpotato farmers seeking effective and eco-friendly pest control solutions. The dosedependent reduction in storage root damage, highlights the effectiveness of Urtica Adamfo Pa as a biopesticide. While Bypel achieved complete suppression, Urtica Adamfo Pa at higher doses (400–500 ml/100 L of water) approached similar efficacy, supporting its potential as a sustainable alternative. The comparable performance across sites reinforces the practical applicability of Urtica Adamfo Pa in integrated pest management (IPM) programs.

Including Urtica Adamfo Pa biopesticides into integrated pest management (IPM) strategies has positive implications for food security. By reducing pest incidence, damage and improving sweetpotato yields, this ecologically friendly solution contributes to the four pillars of food security: availability, access, utilization and stability.

The demonstration of its strong efficacy in suppressing SPVD, minimizing stem basal portion and storage root damage whilst ensuring greater harvest volumes ensures the constant availability of the crop. Secondly optimizing the dosage instead of frequency of application improves cost efficiency which directly translates into economic accessibility due to reduced cost of production. The Adoption of Urtica Adamfo Pa will limit over-reliance on synthetic chemicals, protect the nutritional value of sweetpotato and strengthen nutritional miscellany.

For the purpose of stability, Urtica Adamfo Pa will promote long term soil health and ecosystem resilience. Also, effective pest suppression with the optimized dosage ensures constant production across seasons and reduce scarcity and vulnerability as a result of sweet potato shortage.

The results from this study coupled with previously documented studies confirms that dosage optimization of Urtica Adamfo Pa biopesticide enhances plant health and productivity. In this case, it does not only secure sweetpotato yields but also strengthen food security by ensuring the availability, affordability, safety and stability of sweetpotato supplies along its value chain.

4.0 CONCLUSION

The test product at the application rate of 500ml/100 L of water per week was effective in reducing pest incidence, severity and damage of sweetpotato at both the vegetative stage and storage root formation stage. It was also found to be efficacious in minimizing sweetpotato storage root damage and therefore reducing post-harvest losses. Its efficacy at 500 ml/100 L of water was comparable to the standard reference biopesticide (Bypel). The application of Adamfo Pa resulted in no significant phytotoxic effect on the plants. Moderate to high dosages (400 -500 ml/100L of water) are most effective in reducing vector activity and balancing disease suppression with biomass yield.

The test product Urtica Adamfo Pa is efficacious in the management of coleopteran defoliators and other soil arthropods on sweetpotato. The results of this study not only support the approval of Urtica spp. by the European Food Safety Aauthority (2021) as a plant protection product for crops like carrots, beans, potatoes and strawberries, due to its fungicidal and insecticidal properties, but also added sweetpotato to the list of crops. It also complements the work of Sharma and Singh (2020), that Urtica sp. extracts have insecticidal properties that can act as insect repellents or growth inhibitors. It is therefore a good biopesticide that performs the dual role of insecticidal and fungicidal products.

Ethical approval

Authors declare that there are no ethical issues involved in the conduction of the study.

Conflict of Interests

The authors declare they have no competing interests, be it financial or personal interests, that could have appeared to influence the outcome of the results presented in this paper.

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Author contribution

- Ernestina Narveh Awarikabey: Methodology design, supervision, efficacy assessments, data interpretation, manuscript drafting.
- Ernest Baafi: Field experimentation, statistical analysis, manuscript review.
- Kofi Frimpong-Anin: Trial layout, pest monitoring, data validation, manuscript editing.
- Kwesi A.S. Aidoo: Treatment application oversight, disease monitoring, data curation

- Agbesi K. Keteku: Agronomic support, yield data collection and assessment, manuscript review.
- Franklin Bosompem: Agronomic data management, statistical support.
- Augustine D. Agyekum: Trial layout, site coordination, data collection.
- Maxwell Kwodane: Field logistics, resource management, technical support.
- Richard Yaw Owusu: Technical support, crop safety assessments.

All authors contributed to the conceptualization, methodology design, interpretation of results, approved the final manuscript, and agree to be accountable for the work.

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Data Availability
Data will be made available based on request.

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