

Intercropping and biopesticide-based management of fall armyworm in sweet corn: effects on beneficial arthropods, yield, and economic returns

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ABSTRACT

The fall armyworm, *Spodoptera frugiperda* (Lepidoptera: Noctuidae), a significantly harmful insect pest that causes considerable damage to the foliage and cobs of sweet corn. To identify eco-friendly management practices, this study investigated the effects of soybean intercropping and biopesticides on fall armyworm suppression and on predatory arthropods, pollinator insects, crop traits, yield performance, and economic returns in sweet corn (BU Sweet Corn-1) under field conditions. The results indicated that intercropping alone significantly mitigated fall armyworm infestation across all growth stages compared with monocropping. Notably, the intercrop + Bio-chamak treatment recorded the lowest levels of seedling, pre-tasseling, tasseling, and cob infestation, whereas monocropping showed the highest infestation rates. The abundance of fall armyworm larvae was significantly lower under the Bio-chamak and Spinosad treatments and in soybean–sweet corn intercropping compared with monocropping. Predatory arthropods and pollinator insects were significantly more abundant in soybean–sweet corn intercropping plots, including those treated with biopesticides. Sweet corn plant traits and yield-contributing traits improved markedly under soybean–sweet corn intercropping combined with biorational treatments compared with simple intercropping and monocropping. The enhanced suppression of pests resulted in improved yields, with the intercrop + Bio-chamak treatment achieving the highest yield of 12.3 t ha⁻¹, followed by Spinosad at 10.7 t ha⁻¹, with marginal benefit–cost ratios (MBCR) of 14.8 and 11.6, respectively.

Keywords: Bio-pesticides, Intercropping, Predator, Pollinator, Soybean, *Spodoptera frugiperda*, *Zea mays*

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INTRODUCTION

Sweet corn, *Zea mays* var. *saccharata*, is a valuable crop grown for its tender, sweet kernels harvested at the milk stage, and its short 90–100-day growing cycle provides quick economic returns and nutritional benefits, especially in areas with limited land and water resources (Sahoo and Mohanty, 2020). According to the Food and Agriculture Organization (FAO, 2024), sweet corn cultivation supports the livelihoods of millions of farmers globally,

contributing significantly to food security. Sweet corn provides carbohydrates, dietary fibre, vitamin B, minerals, and antioxidant carotenoids like lutein and zeaxanthin, which support energy, digestion, metabolism, and eye health (Song *et al.*, 2016). As global demand for nutrient-rich, low-fat foods continues to grow, sweet corn represents an important crop for meeting both nutritional and economic needs.

Several varieties of sweet corn are cultivated in

Bangladesh; however, its production faces significant challenges from insect pests, particularly the fall armyworm *Spodoptera frugiperda* (Lepidoptera: Noctuidae). Fall armyworm, a major pest of maize in Bangladesh, possesses polyphagous and highly destructive larvae that infest sweet corn, feeding on leaves, whorls, and ears, causing infestation levels ranging from 43.9% to 90%, depending on the season and the variety of sweet corn cultivated (Amin *et al.*, 2023; Moon *et al.*, 2023; Moon *et al.*, 2024). November to March is the typical period for fall armyworm activity, causing up to 90% yield losses in sweet corn in Bangladesh (Roy *et al.*, 2025).

The fall armyworm reduces sweet corn photosynthesis, growth, and kernel quality, leading to lower yield, marketability, and farmer profitability (Chisonga *et al.*, 2023). In severe cases, fall armyworm can cause complete crop failure, particularly when reliance on chemical pesticides leads to poor long-term control, environmental pollution, and insecticide resistance (Ullah *et al.*, 2023). To address the fall armyworm threat, integrated pest management (IPM), including intercropping sweet corn with legumes such as soybean, cowpea, or pigeon pea, offers a promising strategy combining cultural, biological, and chemical control methods. This approach offers several ecological benefits, including pest suppression, enhanced soil fertility, and increased biodiversity. Recent studies show that intercropping sweet corn with legumes or other companion crops reduces fall armyworm infestation and damage by disrupting its life cycle and supporting natural predators, resulting in higher yields and reduced pesticide dependence compared with corn monoculture (Peter *et al.*, 2024; Yousefi *et al.*, 2024). Additionally, legumes fix nitrogen in the soil, which can benefit sweet corn growth by improving soil fertility.

Alongside cultural practices, biopesticides are increasingly used as an eco-friendly alternative to conventional chemical pesticides. Biopesticides, such as *Bacillus thuringiensis* (Bt) and *Spinosad*, are selective and target specific pests without harming non-target organisms. Biopesticides combined with intercropping reduced fall armyworm larval populations,

improving pest control and crop yield (Abbas *et al.*, 2022). These pesticides are safer for beneficial insects, including pollinators and natural predators, which are essential for maintaining biodiversity in agricultural ecosystems (Aziz *et al.*, 2011). As such, there is a pressing need to explore sustainable management strategies for the fall armyworm, such as combining intercropping with legumes and using biopesticides. Therefore, this study was designed to evaluate the effects of sweet corn–soybean intercropping, involving soybean as a vital legume crop, and biopesticide applications on fall armyworm abundance and infestation, beneficial arthropod abundance, overall crop performance, and economic returns.

MATERIALS AND METHODS

Study Site and Climatic Conditions

The experiment was conducted from July 2024 to June 2025 in the experimental field and laboratory of the Department of Entomology, Gazipur Agricultural University, Gazipur (25°25'N, 89°05'E), Bangladesh. The region has a sub-tropical climate with distinct dry, rainy, and short winter seasons. The average temperature ranged from 12.7°C to 36.0°C, with a relative humidity of 65.8% and an annual rainfall of 237.6 cm (Koli *et al.*, 2025).

Cultivation of Sweet Corn and Soybean Intercropping

Sweet corn seeds (variety BU Sweet Corn-1) were obtained from the Department of Entomology, and soybean seeds (variety BU Soybean-2) from the Department of Agronomy, Gazipur Agricultural University. Both crops were sown with soybean intercropped between sweet corn rows. The experimental plots were laid out in a randomized complete block design with three replications. A total of 12 experimental plots, each measuring 2.5 m × 2.5 m, were established with 1 m spacing between adjacent plots and blocks. Sweet corn plants were spaced 25 cm apart within rows, with 50 cm between rows. Each plot contained five rows, with 10 sweet corn plants per row. In the intercropping system, soybean seeds were sown in alternating rows between the sweet corn rows. Routine intercultural practices, including irrigation, weeding, and thinning, were

performed as required, with additional irrigation during tasseling and cob development. Fertilisers were applied following the Fertiliser Recommendation Guide (FRG 2018).

Spraying of Biopesticides

Two biopesticides, Bio-chamak (*Celastrus angulatus* 1% EW) and Spinosad (*Saccharopolyspora spinosa* 2.5% SC), were each applied at a concentration of 2.5 mL L⁻¹ of water. Spraying was done four times at the onset of fall armyworm infestations: at the seedling stage (up to 3 leaves), the pre-tasseling stage (5–7 leaves), the tasseling stage, and the cob milk stage. The experimental treatments consisted of sweet corn intercropped with soybean, sweet corn intercropped with soybean + Bio-chamak, sweet corn intercropped with soybean + Spinosad, and sweet corn monocropping as the untreated control. Sweet corn monocropping (control plot) and sweet corn intercropped with soybean received no biopesticide application.

Abundance of Fall Armyworm Larvae and Plant Infestation

Data on the abundance of fall armyworm larvae were collected by direct visual observation in the experimental plots one day after the application of the biopesticides. From each experimental plot, 10 plants were randomly selected to ensure unbiased sampling, and each plant was carefully inspected for fall armyworm larvae. Larvae found on leaf whorls, leaf surfaces, or feeding sites were counted and recorded on a per-plant basis. Total plant counts and the number of infested plants in each plot were visually counted at each growth stage, and the infestation level for each treatment was calculated as a percentage.

Observation on the Abundance of Predatory Arthropods and Pollinator Insects

Data on the abundance of predatory arthropods and pollinator insects were collected by direct visual observation in the experimental plots one day after the application of the biopesticides. On each monitoring day, one row per plot was randomly selected, and the abundance of predator insects, spiders, and pollinator insects at different vegetative and reproductive stages was recorded for all 10 plants in the row during a 5-minute observation period from the midpoint of the row. The mean number of predator and

pollinator individuals per row was then calculated.

Yield of Sweet Corn and Soybean

At the cob milking stage, one row was randomly selected from each plot, and plant agronomic traits-including plant height, base diameter, third internode length, number of nodes, number of leaves, and leaf length and width at the midpoint of each plant in the row-were measured. Yield-contributing traits-cobs per plant, cob length, cob diameter, cob weight, and number of grains per cob-were recorded at harvest from mature cobs. One row from each plot was randomly selected, and data on these yield-contributing traits were collected from the plants in that row. The harvested corn cobs and soybean pods from each plot under the four different treatments were dried and weighed using a precision weighing machine, and the yield for each treatment was calculated and expressed in tons per hectare.

Economic Analysis

The Benefit-Cost Ratio (BCR) was calculated based on the total expenditure for each treatment and the total return per hectare. The total expenditure for each treatment included the costs associated with labour and inputs. The gross return for each treatment was determined by multiplying the total yield by the market price of the harvested grain. The net return for each treatment was then calculated by subtracting the total expenditure from the gross return. The adjusted net return for each treatment was calculated by subtracting the control net return from the treatment net return. Finally, the BCR was calculated by dividing the adjusted net return of each treatment by its total expenditure. Additionally, the Marginal Benefit-Cost Ratio (MBCR) was calculated to evaluate the incremental benefits relative to the additional costs incurred by each treatment.

Statistical Analysis

A one-way analysis of variance (ANOVA) was conducted to evaluate the data under the different treatments. Tukey's Honestly Significant Difference (HSD) post hoc test was applied at a 5% significance level to identify significant differences between treatments.

RESULTS

The abundance of fall armyworm larvae per plant across four treatments and at various sweet corn growth stages varied significantly (Table 1). Sweet corn monocropping consistently exhibited the highest larval abundance across all stages compared with the other treatments during the seedling, pre-tasseling, tasseling, and cob milking stages. In contrast, the treatments involving sweet corn intercropping with soybean, soybean + Bio-chamak, and soybean + Spinosad showed consistently lower larval abundance. Among these, the soybean intercropping + Bio-chamak treatment generally showed the lowest larval abundance.

The fall armyworm infestation rates (%) across four treatments at various sweet corn growth stages differed significantly, and the sweet corn monocropping treatment showed higher infestation levels at all growth stages than the other treatments (Table 2). The infestation rates in the sweet corn monocropping treatment at the seedling, pre-tasseling, tasseling, and cob milking stages were 36.5 ± 1.8 , 43.9 ± 2.3 , 43.9 ± 2.3 , and $40.1 \pm 1.1\%$, respectively. Intercropping with soybean + Bio-chamak resulted in the lowest infestation rates, particularly at the seedling, pre-tasseling, tasseling, and cob milking stages, and was statistically similar to the soybean intercropping + Spinosad treatment.

The abundance of predatory arthropods associated with sweet corn among the treatments varied significantly (Table 3). The Occurrence of the predatory arthropods, including ladybird beetles, rove beetles, spiders, green lace wings, dragonflies, and damselflies among the treatments ranged from 6.7 ± 0.2 to 9.7 ± 0.5 , 4.1 ± 0.2 to 8.1 ± 0.1 , 3.2 ± 0.1 to 5.8 ± 0.2 , 3.3 ± 0.1 to 4.4 ± 0.1 , 4.9 ± 0.1 to 7.8 ± 0.1 , and 4.2 ± 0.2 to 8.5 ± 0.2 per row, respectively. Predator abundance was significantly highest in soybean–intercropped plots, followed by Spinosad- and Bio-chamak-treated intercropped plots, while the lowest number of predators was recorded in sweet corn monocropped plots.

The abundance of pollinator insects differed significantly among the four treatments, with sweet corn monocropping showing the lowest abundance across all pollinator insects (Table 4).

The numbers of honeybees, hoverflies, sweat bees, carpenter bees, sulphur butterflies and syrphid flies were statistically similar in the soybean–sweet corn intercropping and soybean–sweet corn intercropping + bio-pesticide treatments than in the sweet corn monocrop.

Sweet corn plant traits differed significantly among the four management treatments (Table 5). Plant height, base diameter, internode length, number of nodes per plant, number of leaves per plant, leaf length, and leaf width differed among the treatments. The agronomic traits were significantly greater in plots where sweet corn was intercropped with soybean and supplemented with either Bio-chamak or Spinosad compared with both the simple intercrop and the monocropped control.

Across the different management packages, yield-contributing traits and yield of sweet corn showed clear and consistent improvement under legume–sweet corn intercropping combined with biopesticide treatments compared with simple intercropping and monocropping (Table 6). The results showed that the number of cobs per plant, cob length, cob diameter, cob weight, number of grains per cob, and yield among the treatments ranged from 1.8 ± 0.1 to 2.7 ± 0.2 per plant, 14.8 ± 0.1 to 20.1 ± 0.3 cm, 3.4 ± 0.1 to 4.2 ± 0.1 cm, 188.8 ± 7.2 to 209.1 ± 2.1 g, 483.1 ± 3.2 to 563.2 ± 3.1 per cob, and 3.2 ± 0.5 to 12.3 ± 0.2 t ha⁻¹, respectively.

The economic analysis of the different treatments, as shown in Table 7, reveals that intercropping with soybean+Bio-chamak has the highest marginal benefit-cost ratio (MBCR) of 14.8, indicating it is the most economically efficient treatment. With a management cost of 416.6 USD, it yields 6729.1 USD in net returns and an adjusted net return of 6174.2USD, making it the most profitable option. In comparison, intercropping with soybean has a lower MBCR of 11.1, with net returns of 4016.6 USD and an adjusted net return of 3685.0, reflecting moderate economic efficiency. Intercropping with soybean + Spinosad also shows a relatively high MBCR of 11.6 and net returns of 5789.1 USD, though its economic efficiency is still slightly lower than that of the Bio-chamak-enhanced treatment. The sweet

Table 1. Effect of soybean–sweet corn intercropping and biopesticides on the abundance of fall armyworm larvae at different growth stages of sweet corn plants

Treatment	Abundance (number plant ⁻¹) at different growth stages			
	Seedling (up to 3 leaves)	Pre-tasseling (5-7 leaves)	Tasseling	Cob milking
Intercropped with Soyabean	0.5±0.0b	1.1±0.1bc	1.1±0.2b	1.2±0.2b
Intercropped with soybean + Bio-chamak	0.4±0.0b	0.8±0.1c	0.9±0.1b	0.9±0.4b
Intercropped with Soyabean + Spinosad	0.5±0.0b	1.0±0.1c	1.1±0.1b	1.2±0.1b
Sweet corn monocropping	0.8±0.1a	1.5±0.1a	1.4±0.3a	1.4±0.5a

Data expressed as mean±se. Means within a column followed by the same letter(s) are not significantly different by Tukey HSD post hoc statistic at $p < 0.05$.

Table 2. Effect of soybean–sweet corn intercropping and biopesticides on sweet corn infestation by fall armyworm larvae at different growth stages

Treatment	Infestation rate (%)			
	Seedling (up to 3 leaves)	Pre-tasseling (5-7 leaves)	Tasseling	Cob milking
Intercropped with Soyabean	23.8±2.5b	32.4±2.5b	33.5±2.1b	30.6±1.5b
Intercropped with soybean + Bio-chamak	23.1±3.8b	19.2±1.1c	20.5±1.2c	10.8±0.5c
Intercropped with Soyabean + Spinosad	23.8±1.5b	24.4±0.5bc	25.5±0.1c	14.5±0.5c
Sweet corn monocropping	36.5±1.8a	43.9±2.3a	43.9±2.3a	40.1±1.1a

Data expressed as mean±se. Means within a column followed by the same letter(s) are not significantly different by Tukey HSD post hoc statistic at $p < 0.05$.

Table 3. Effect of soybean–sweet corn intercropping and bio-pesticides on the abundance of predatory arthropods associated with sweet corn plants

Treatment	Abundance (number row ⁻¹)					
	Ladybird beetle	Rove beetle	Spider	Green lacewing	Dragon fly	Damsel fly
Intercropped with Soyabean	9.7±0.5a	8.1±0.1a	5.8±0.2a	4.4±0.1a	7.8±0.1a	8.5±0.2a
Intercropped with soybean + Bio-chamak	8.3±0.4ab	4.6±0.2bc	3.7±0.1bc	3.4±0.1b	5.5±0.1bc	5.8±0.1c
Intercropped with Soyabean + Spinosad	8.6±0.2a	6.1±0.1b	4.2±0.1b	3.8±0.2b	6.0±0.1b	7.3±0.2b
Sweet corn monocropping	6.7±0.2c	4.1±0.2c	3.2±0.1c	3.3±0.1b	4.9±0.1c	4.2±0.2d

Each row contained 10 sweet corn plants. Data expressed as mean±se. Means within a column followed by the same letter(s) are not significantly different by Tukey HSD post hoc statistic at $p < 0.05$.

Table 4. Effect of soybean–sweet corn intercropping and biopesticides on the abundance of pollinator insects associated with sweet corn plants

Treatment	Abundance (number row ⁻¹)					
	Honeybee	Hoverfly	Sweat bee	Carpenter bee	Sulphur butterfly	Syrphid fly
Intercropped with Soyabean	4.1±0.1a	2.5±0.1a	2.4±0.1a	1.2±0.2a	4.3±0.2a	2.8±0.3a
Intercropped with soybean + Bio-chamak	3.8±0.2a	2.1±0.1a	2.1±0.2a	0.9±0.1a	4.6±0.3a	2.6±0.2a
Intercropped with Soyabean + Spinosad	3.9±0.1a	2.5±0.2a	1.9±0.1a	1.1±0.1a	3.8±0.1a	1.9±0.2a
Sweet corn monocropping	2.1±0.1b	1.3±0.1b	0.9±0.2b	0.5±0.1b	2.1±0.1b	0.8±0.1b

Each row contained 10 sweet corn plants. Data expressed as mean±se. Means within a column followed by the same letter(s) are not significantly different by Tukey HSD post hoc statistic at $p < 0.05$.

Table 5. Effect of legume–sweet corn intercropping and bio-pesticides on the sweet corn plant traits under fall armyworm infestation

Treatment	Plant height (cm)	Base diameter (cm)	Length of internode (cm)	Nodes per plant	Leaf per plant	Leaf length (cm)	Leaf width (cm)
Intercropped with Soyabean	128.1±1.8b	1.6±0.0b	10.6±0.2ab	11.7±0.2b	10.5±0.6b	60.2±0.9bc	7.4±0.2bc
Intercropped with soybean + Bio-chamak	149.1±1.3a	2.1±0.1a	11.3±0.2a	13.4±0.3a	13.8±0.7a	62.7±0.7ab	8.2±0.2ab
Intercropped with Soyabean + Spinosad	152.3±1.8a	2.1±0.1a	11.6±0.3a	13.5±0.3a	13.9±0.7a	64.8±0.9a	8.7±0.1a
Sweet corn monocropping	126.1±1.4b	1.8±0.1ab	9.5±0.3b	11.1±0.2b	9.3±0.2b	57.4±0.4c	6.4±0.2c

Data expressed as mean±se. Means within a column followed by the same letter(s) are not significantly different by Tukey HSD post hoc statistic at $p < 0.05$.

Table 6. Effect of soybean–sweet corn intercropping and biopesticides on yield-contributing traits of sweet corn under fall armyworm infestation

Treatment	Cobs per plant	Cob length (cm)	Cob diameter (cm)	Cob weight (g)	Grains per cob	Yield (t/ha)
Intercropped with Soyabean	2.0±0.1b	16.4±0.7b	4.0±0.1b	195.6±3.3bc	516.6±2.3b	7.5±0.7b
Intercropped with soybean + Bio-chamak	2.6±0.1a	20.1±0.3a	4.2±0.1b	203.2±3.6ab	542.6±8.9a	12.3±0.2a
Intercropped with Soyabean + Spinosad	2.7±0.2a	18.6±0.4a	4.2±0.1a	209.1±2.1a	563.2±3.1a	10.7±0.5ab
Sweet corn monocropping	1.8±0.1b	14.8±0.1c	3.4±0.1c	188.8±7.2c	483.1±3.2c	3.2±0.5c

Data expressed as mean±se. Means within a column followed by the same letter(s) are not significantly different by Tukey HSD post hoc statistic at $p < 0.05$.

Table 7. Effect of soybean–sweet corn intercropping and biopesticides on the economic returns of fall armyworm management in sweet corn cultivation

Treatment	Management cost (USD)	Gross return (USD)	Net return (USD)	Adjusted net return (USD)	MBCR
Intercropping with soybean	333.3	4350.0	4016.6	3685.0	11.1
Intercropping with soybean + Bio-chamak	416.6	7145.0	6729.1	6174.2	14.8
Intercropping with soybean + Spinosad	458.3	6247.0	5789.1	5315.2	11.6
Sweet corn monocropping	291.7	1890.0	1598.3	1468.4	5.0

corn monocropping treatment has the lowest MBCR of 5.0 and a net return of 1598.3 USD, indicating it is the least economically efficient of the treatments evaluated.

DISCUSSION

Intercropping is a key component of Integrated Pest Management (IPM), involving the spatial and temporal integration of multiple crop species. It enhances biodiversity, modifies the crop microenvironment, and suppresses pest populations through ecological disruption and the inclusion of repellent species. In our study, soybean intercropping combined with Bio-chamak or Spinosad significantly reduced larval populations and infestation rates across different sweet corn growth stages, with the lowest occurrences and infestations observed under soybean intercropping + Bio-chamak, and monocropping consistently recorded the highest abundances. These findings indicate that monocropping is more susceptible to fall armyworm infestation, whereas integrated approaches involving intercropping and biopesticides effectively suppress fall armyworm abundance and infestation. Monocropping consistently showed the highest abundance and infestation, whereas soybean intercropping combined with Bio-chamak or Spinosad significantly reduced infestation, indicating the effectiveness of these integrated management practices. Mukanga *et al.* (2024) reported that intercropping reduced fall armyworm infestation, with the highest reduction observed in maize–cowpea intercropping (34.6%), followed by maize–groundnut (25.7%), and the lowest reduction in maize–pumpkin intercropping (15.6%). It has also been noted that some additional plants, such as border intercropping with napier grass and

row intercropping with marigold, are useful for the sustainable control of fall armyworm (Hailu *et al.*, 2018).

Intercropped plants release volatile organic compounds that mediate plant–biotic and abiotic interactions and act as natural repellents, making them an effective pest management tool, and intercropping has also been proven to reduce fall armyworm damage on crops (Razo-Belman and Ozuna, 2023; Jalloh *et al.*, 2023). Research has shown that intercrops can reduce fall armyworm oviposition by emitting olfactory camouflage and repellent volatile organic compounds (Sobhy *et al.*, 2022).

Bio-chamak and Spinosad, when integrated with soybean intercropping, significantly reduced fall armyworm larval populations and infestation levels compared to soybean–corn intercropping alone, indicating the effectiveness of combining cultural and biorational control strategies. Bio-chamak, derived from *Celastrus angulatus*, contains the key bioactive compound celangulin, a non-alkaloidal sesquiterpene polyol ester recognized as a potent antifeedant against lepidopteran pests (Wakabayashi *et al.*, 1988). Such antifeedant properties are essential in pest management because they disrupt insect feeding behavior, thereby protecting crop tissues and limiting further damage, which is particularly important for managing highly destructive pests such as fall armyworm (Togola *et al.*, 2025). In addition, Spinosad exhibits relatively low toxicity to many non-target organisms while maintaining strong efficacy against target pests (Singh and Mazumdar, 2022), and spinosyn-based insecticides have been reported to cause more than 90% larval mortality within 48 to 72 hours after application under laboratory conditions (Idrees *et al.*, 2022). Together, these

findings highlight the complementary role of intercropping and biopesticides in achieving effective and environmentally sound fall armyworm management.

Intercropping creates a diversified habitat, and this crop diversification increases the population and activity of natural enemies, thereby improving pest management (Harrison *et al.*, 2019). Li *et al.* (2022) reported that intercropping soybean in a corn field significantly enhances the abundance and diversity of insect communities, including natural enemies and pollinator-associated species, compared to corn monoculture. In this study, the abundance of predatory arthropods and pollinators differed significantly among treatments, with legume–sweet corn intercropping, either alone or combined with Bio-chamak or Spinosad, showing higher abundance than monocropping. Soybean used as an intercrop served as a refuge for insect communities, enhanced their abundances, and favoured key generalist predators and pollinators, while specific biopesticide combinations promoted particular arthropod groups. Overall, intercropping increased predator and pollinator abundance, while Bio-chamak supported specific arthropod groups and Spinosad had minor suppressive effects on sensitive taxa.

Agronomic and yield-contributing traits of sweet corn were significantly improved under soybean intercropping combined with Bio-chamak or Spinosad compared with simple intercropping and monocropping, indicating that integrated management enhances plant growth and canopy development, likely through improved plant vigour and reduced pest pressure. Soybean–sweet corn intercropping is also recognized as a sustainable agricultural practice that improves land-use efficiency and often results in taller sweet corn plants with higher ear placement compared to monoculture systems (Li *et al.*, 2022). Metwally *et al.* (2026) reported that intercropping soybean with corn increased grain yield per plant and yield per hectare by 7.5% and 4.2%, respectively, compared with sole corn cultivation. Collectively, these findings highlight the agronomic and yield advantages of soybean-based intercropping systems, particularly when

integrated with biopesticide applications, for enhancing productivity and sustainability in maize–sweet corn production systems.

Economic analysis demonstrated that soybean intercropping combined with Bio-chamak achieved the highest marginal benefit–cost ratio, indicating superior cost-effectiveness and profitability among the evaluated treatments. This result highlights the economic advantage of integrating legume intercropping with biopesticide application over conventional monocropping systems in sweet corn cultivation. These findings are further supported by Adhikari *et al.*, (2025), who reported that maize–legume intercropping systems significantly suppress fall armyworm infestation, enhance grain yield, and promote beneficial arthropod abundance, thereby improving overall crop performance and strengthening agroecosystem resilience.

The study demonstrates that sweet corn monocropping is highly susceptible to fall armyworm infestation, whereas soybean intercropping combined with the biopesticides Bio-chamak or Spinosad effectively reduces pest pressure across growth stages. Among the treatments, soybean intercropping with Bio-chamak provided the best balance of pest control, yield improvement, and economic return, highlighting the value of integrated, legume-based management strategies for sustainable and profitable sweet corn production.

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