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EFFICACY OF SELECTED SYNTHETIC INSECTICIDES FOR THE CONTROL OF FALL ARMYWORM (*SPODOPTERA FRUGIPERDA*) IN MAIZE (*ZEA MAYS* L.) AFGOI, SOMALIA

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ABSTRACT

The study evaluated the efficacy of two synthetic insecticides, Ampligo 150 ZC and Match 050 EC, each applied at three different dosages against Fall armyworm (*Spodoptera Frugiperda*) infestation in Maze under the field conditions in Afgoi, Somalia. A Randomized Complete Block Design (RCBD) with three replications was used, with treatments including six insecticide dose combinations and one control. Data on leaf damage scores and live larvae per plant were collected across three spray rounds. Statistical analysis used ANOVA and Kruskal-Wallis tests to assess treatment effects. Results showed significant differences in both leaf damage and larval counts among treatments ($P < 0.001$). Ampligo 150 ZC consistently outperformed Match 050 EC across all rounds, with 5mL/10L and 7.5 mL/10L doses showing the lowest leaf damage and larval survival. In contrast, untreated control plots showed the highest infestation levels. While Match 050 EC showed moderate effectiveness, its performance was inconsistent, particularly at higher doses. The findings revealed Ampligo 150 ZC as a highly effective option for managing Fall armyworm in smallholder maize systems. However, the study underscores the need for caution regarding synthetic pesticide reliance due to potential health risks and resistance development. Future research should incorporate yield and cost-benefit analyses and explore integration into broader integrated pest management strategies. These results offer critical insights for enhancing food security through improved pest control practices in Somalia's maize production systems.

Keywords: Fall Armyworm, Synthetic Insecticides, Ampligo 150ZC, Match 050 EC, Maize

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1. INTRODUCTION

Maize (Zea mays L.) is a key crop in global agriculture, serving as an essential staple for food, animal feed, and fodder. In addition to its significance for basic nutrition, maize is also widely utilized in various industries, including the production of beverages, paper, pharmaceuticals, and textiles (Blümmel et al., 2013).

In Somalia, maize accounts for approximately 30 percent of the nation's total cultivated land, covering more than 15,000 hectares. Due to the limited application of local harvests in Somalia, yield growth in rain-fed conditions, using fertilizers, and excessive disease and pest management, maize yields in farmers' fields range from 800 to 1000 kg/ha (Hussein, 2023).

Between 2019 and 2022, maize production in Somalia showed notable fluctuations. In 2019, the total production was approximately 57,000 metric tons. This increased significantly in 2020 to 75,000 metric tons, indicating a strong year for maize output. However, production dropped sharply in 2021 to 49,000 metric tons, likely due to adverse climatic conditions and pest infestations. In 2022, maize production rebounded to 65,000 metric tons, reflecting a partial recovery (Agro Somalia, 2024).

The fall Armyworm (*Spodoptera frugiperda*) has emerged as a major threat to maize production in Somalia, with its aggressive increase causing important damage to the maize, which is a staple food and a crucial source of income for smallholder farmers (Mutyambai et al., 2022).

The pest's effect spreads beyond crop damage, affecting food security, household incomes, and national economies, particularly in parts where maize is a dietary staple and a key source of livelihood (Togola et al., 2025).

In general, the abovementioned problems suggest the necessity for establishing an effective combined management plan for the sustainable control of this aggressive pest. Therefore, this study aims to evaluate the efficacy of two selected synthetic insecticides against fall Armyworm infestation in the maize crop, with each containing three different doses under field conditions at Afgoi district, Lower Shabelle region, Somalia.

2. LITERATURE REVIEW

According to (Overton et al., 2021) An assessment of global harvest losses and control thresholds for fall armyworm. The study revealed significant changeability in stated yield losses, with experimental trials indicating average losses of 17.3 percent, while farmer surveys reported higher losses, averaging 35.6 percent. Findings showed that crops treated with synthetic insecticides generally had better yield orientation. The study’s limitation is the need for standardized measurement metrics.

According to (Kumela et al., 2019) they found that most farmers relied heavily on synthetic insecticides for fall armyworm control, with products like lambda-cyhalothrin and chlorpyrifos being commonly used. Although chemical control was perceived as effective. The study did not evaluate the field-level efficacy of specific insecticides under local conditions or provide comparative data on dosages, cost effectiveness, and farmer accessibility.

A study conducted in India evaluated the field efficacy of various insecticides against *S. frugiperda* was reported for the first time, producing severe injury on maize. The results indicated that Emamectin benzoate 5 SG presented the maximum severe toxicity, followed by chlorantraniliprole18.5 SC, and spinetoram 11.7 SC, while the toxicities of flubendiamide 480 SC, indoxacarb 14.5 SC, lambda-cyhalothrin5 EC, and novaluron10 EC were at par by the leaf-dip bioassay. The outcomes of field efficacy for two sowing dates (Jun planted crop, and Sep planted crop 2018) exposed that the effective insecticides were chlorantraniliprole 18.5 SC, followed by emamectin benzoate 5 SG, spinetoram 11.7 SC, flubendiamide 480 SC, indoxacarb 14.5 SC, lambda cyhalothrin 5 EC, and novaluron 10 EC (Deshmukh et al., 2020).

(Idrees et al., 2022) Conducted a laboratory study to evaluate the efficacy of seven synthetic insecticides representing spinosyns, lambda-cyhalothrin, pyrethroids, avermectins, and diamides against second instar FAW larvae. Their findings indicated that the broflanilide, abamectin, and spinetoram outperformed all other insecticides by causing larval mortality of 70.7, 68.0, and 67.3%, respectively, followed by lambda-cyhalothrin 65.3% to the second instar *S. frugiperda*.

While these results underscore the potential of certain insecticides for rapid suppression of FAW populations, the authors emphasize that laboratory efficacy must be validated under field conditions to ensure practical applicability. This highlights a critical gap that the present study seeks to address by evaluating the field performance of selected synthetic insecticides against FAW in maize production in Afgoi, Somalia.

This study addresses this gap by evaluating the field efficacy of selected synthetic insecticides under the local conditions of the Afgoi district, offering insights tailored to Somali maize farmers for sustainable and context-appropriate fall armyworm management.

3. MATERIALS AND METHODS

Field research was conducted at the experimental farm of Benadir University, Afgoi district. Afgoi is located about 30 kilometers west of Mogadishu. The Shebelle River passes through the middle of the city. It is a zone appropriate for agriculture. The soil of the experimental place is clay in texture with high water holding capacity.

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each replication entails of 7 plots, which normally makes a total of 21 experimental

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units. Each plot covers four rows with a length of 7.2 m and a width of 3.2 m, which brings a plot area of 23.04 m^2. The spacing was 0.8 M×0.3 M between rows and plants, respectively. The treatments consisted of two factors, viz. different insecticides (Ampligo 150 ZC and Match050 EC), and each insecticide had three different doses (2.5 ml,5 ml,7.5 ml, 6 ml,7 ml, and 8 ml per 10 ml, respectively). The treatments consisted of a combination of the product and the associated dose as follows:

T_1= Ampligo 150 ZC 2.5ml/10L, T_2= Ampligo 150 ZC 5ml/10L, T_3=Ampligo 150 ZC 7.5ml/10L, T_4=Match050 EC 6ml/10L, T_5= Match050 EC 7ml/10L, T_6= Match050 EC 8ml/10L, and T_7=Control.

3.1 Experimental procedure

The first operation involved ploughing with a Mould board plough, with an area of 7.2 m in length and 3.2 m in width, totaling 23.04 m². The second operation is by using an offset disc harrow, and then followed by a Ridger and disc bund former. The farm obtained four irrigations which including zero irrigation, and it was furrow irrigation.

3.2 Data collection method

The data on leaf damage score and number of leaves per plant were collected from each plot. A total of ten plants in each plot were randomly collected for leaf damage score on six leaves, and five plants for the number of larvae per plant. The plots were sprayed three times, and the data were collected on three different dates. Data were collected on 29th May, 5th June, and 12th June, following regular periodical spraying applied on 23rd April, 30th April, and 7th May, respectively.

3.3 Statistical analysis

Mean numbers of FAW larvae obtained from field trials were subjected to one-way analysis of variance (ANOVA) using a generalized linear model. Field trials were arranged in a randomized complete block design (RCBD). The significance level was set at 0.05, and Tukey's honest significant difference test separated the means. Leaf damage score data were categorical variables and were analyzed using the Kruskal–Wallis test. All statistical analyses were performed using the R software.

4. RESULTS AND DISCUSSION

Field evaluation of synthetic insecticides against fall armyworm

4.1 Leaf damage score

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In general, Leaf damage caused by Fall Armyworm larvae was significantly different among treatments in all the spray rounds. An extensive leaf injury by FAW larvae was shown by non-treated control plants compared to the synthetic insecticide-treated plants.

4.1.1 First-round spraying

Leaf damage caused by FAW larvae was significantly different among treatments during the first-round spraying (H = 17.05, *df* = 6, *P*< 0.0075). In this round, the lowest leaf damage was recorded from plants treated with Ampligo ZC with the dose of 2.5ml/10L, followed by the same insecticide with the dose of 7.5ml/10L (Figure 1).

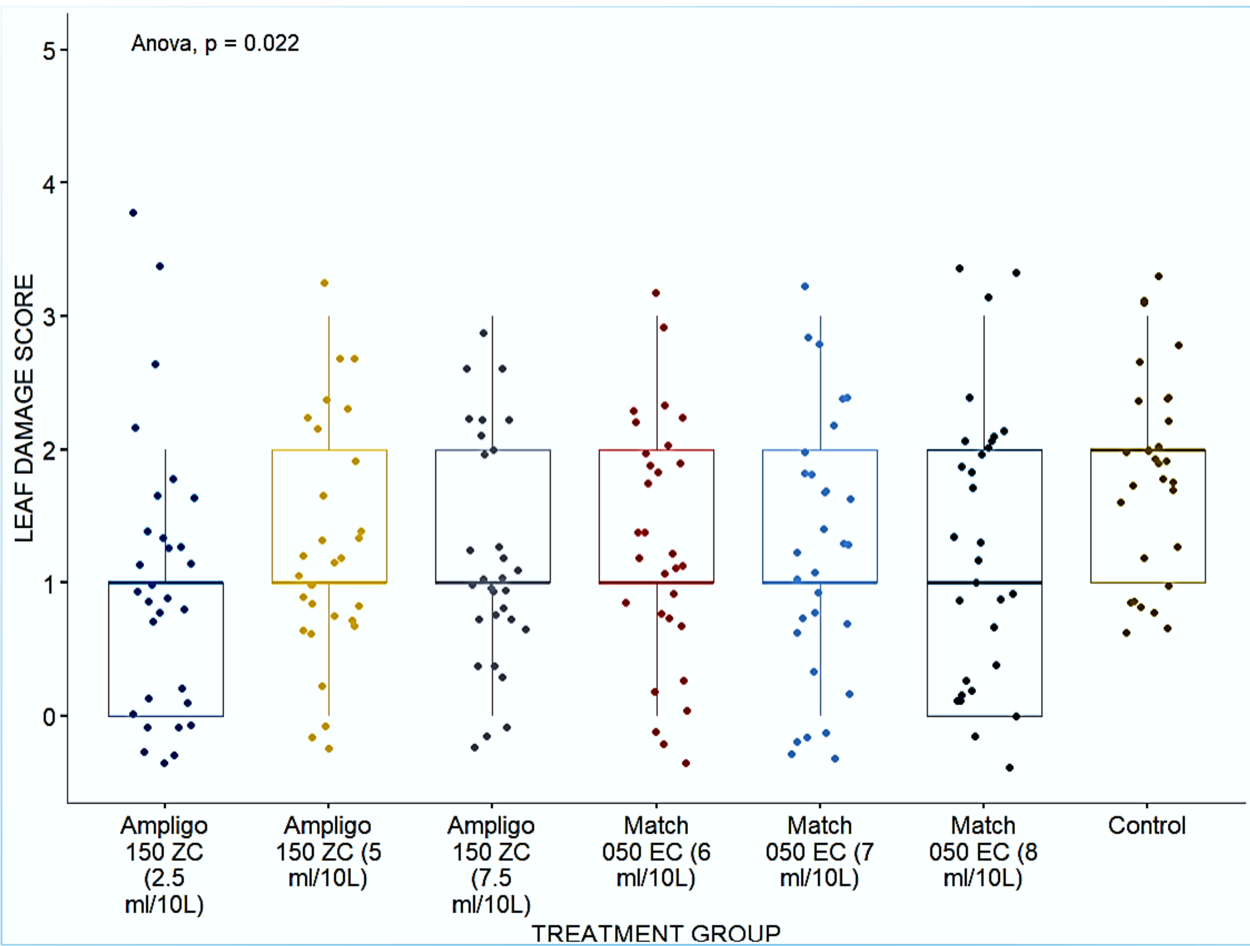

Figure 1: Mean (±SEM) of leaf damage of maize inflicted by Fall Armyworm under different treatments in the field after first-round spraying

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4.1.2 Second-round spraying

The scores of the leaf damage inflicted by FAW were significantly different among treatments in the second-round spraying (H = 54.69, df = 6, P< 0.001). The minimum leaf damage score was recorded in plants treated with Ampligo 150 ZC 5ml/10L, followed by Ampligo 150 ZC 7.5ml/10L. (Figure 2)

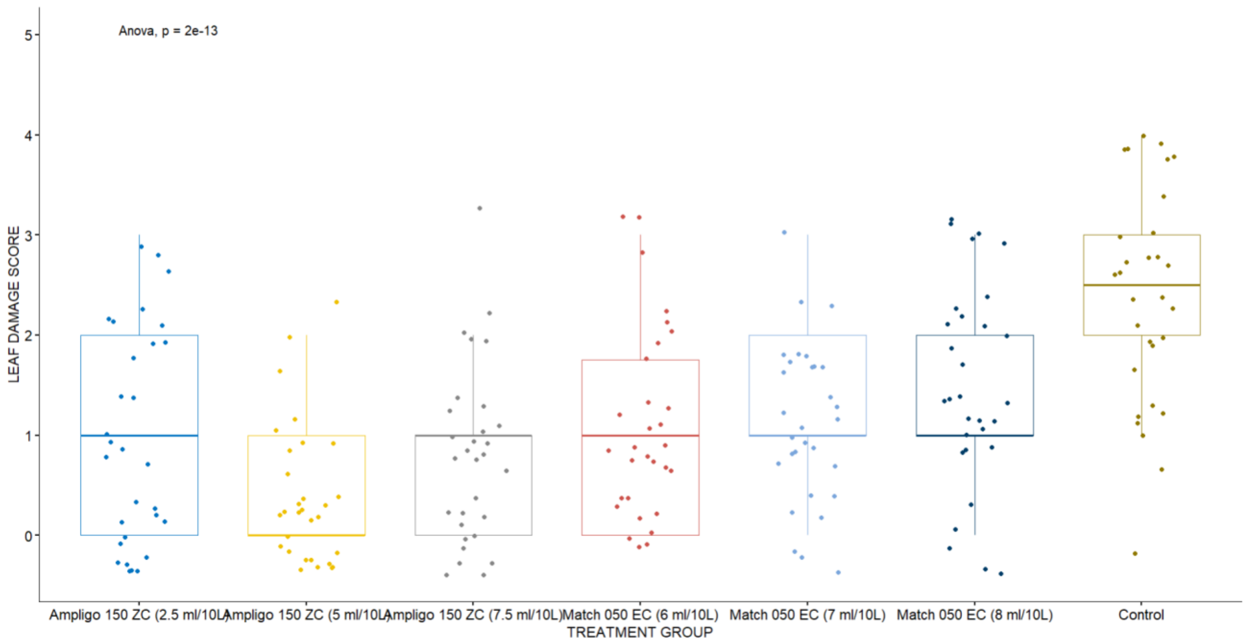

Figure 2: Mean (±SEM) of leaf damage of maize inflicted by Fall Armyworm under different treatments in the field after second-round spraying

4.1.3 Third-round spraying

The scores of leaf damage inflicted by *Spodoptera frugiperda* were significantly different among treatments in the third round of spraying (Kruskal-Wallis test, H=75.17, df=6, P < 0.001). the lowest leaf damage was observed in plants treated with Ampligo 150 ZC at 5 mL/10 L, and Ampligo 150 ZC at 7.5 mL/10 L. (Figure 3)

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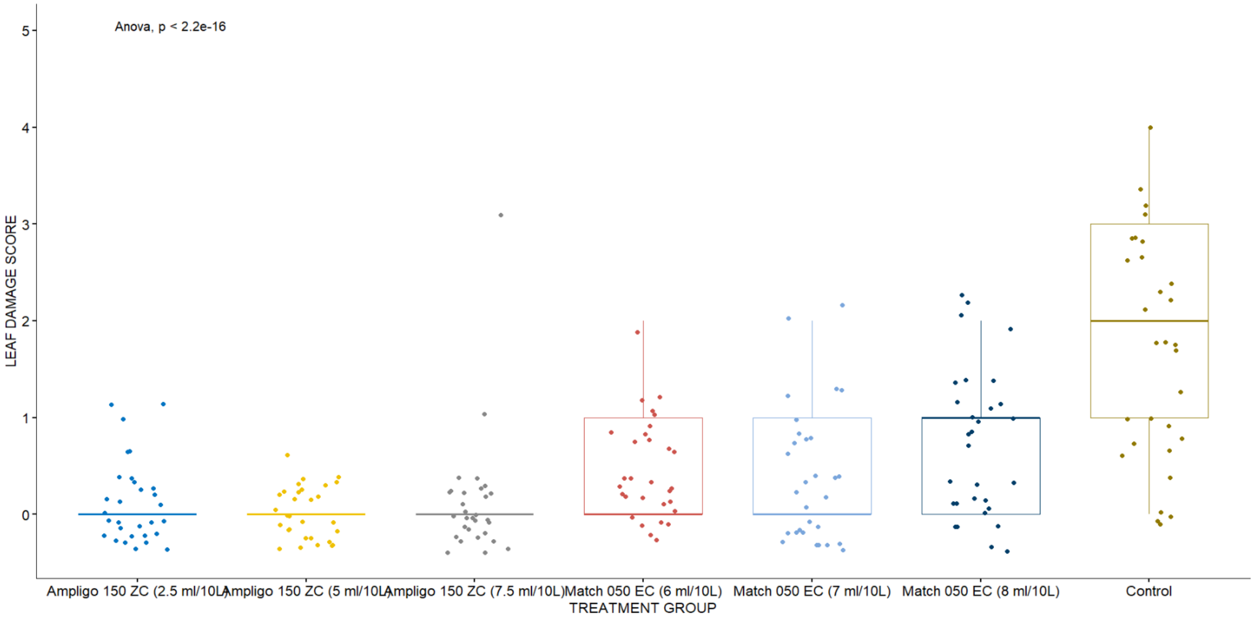

Figure 3: Mean (±SEM) of leaf damage of maize inflicted by Fall Armyworm under different treatments in the field after second-round spraying

4.2 Number of larvae alive

Taken together, the results indicated that the number of live larvae in untreated plants was higher compared to the treated plants.

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4.2.1 First-round spraying

The number of live larvae was significantly reduced in treated plants in the first-round spraying ($F_{6,98} = 6.81$, $P < 0.001$). During this round, the minimum mean number of FAW larvae alive was generally recorded in Ampligo-treated maize plants, whereas the maximum number was recorded on the non-treated plants (Table 1).

4.2.2 Second-round spraying

Likewise, results indicated that the mean number of FAW larvae alive was significantly different during the second-round sprayings ($F_{6,98} = 5.36$, $P < 0.001$). What stands out in this result is that no larvae were recorded from all Ampligo-treated maize plants, while the highest mean live larvae number was found from plants sprayed with no chemicals (Table 1)

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Table 1: Mean number (± SEM) of Fall Armyworm larvae alive under different treatments application in the field following three spray rounds

Treatment Group	Spray Round 1	Spray Round 2	Spray Round 3
Ampligo 150 ZC (2.5 ml/10L)	0.00 ± 0.43[a]	0.00 ± 0.43[a]	0.07 ± 0.43[a]
Ampligo 150 ZC (5 ml/10L)	0.33 ± 0.43[a]	0.00 ± 0.43[a]	0.07 ± 0.43[a]
Ampligo 150 ZC (7.5 ml/10L)	0.13 ± 0.43[a]	0.00 ± 0.43[a]	0.00 ± 0.43[a]
Control	3.40 ± 0.43[b]	2.13 ± 0.43[b]	4.33 ± 0.43[b]
Match 050 EC (6 ml/10L)	0.87 ± 0.43[a]	0.87 ± 0.43[ab]	0.47 ± 0.43[a]
Match 050 EC (7 ml/10L)	0.40 ± 0.43[a]	0.67 ± 0.43[ab]	0.87 ± 0.43[a]
Match 050 EC (8 ml/10L)	0.40 ± 0.43[a]	0.53 ± 0.43[ab]	1.13 ± 0.43[a]
ANOVA			
F	6.81	5.36	16.7
DF	6	6	6
P	<0.001	<0.001	<0.001

4.2.3 Third-round spraying

In this round, results revealed that the mean number of live larvae was significantly lower in all treated plants ($F_{6,98} = 16.66$, $P < 0.001$) as compared with the check (unsprayed plants). Furthermore, no live larvae were recorded from plants sprayed with Ampligo 150 ZC 7.5ml/10L (Table 1).

The current study set out with the purpose of assessing the efficacy of two synthetic insecticides with each containing three different doses, for the control against Fall Armyworm (FAW), Spodoptera frugiperda (Lepidoptera: Noctuidae) infestation in maize crop in Afgoi district. The results of this study indicate that leaf damage score caused by Fall armyworm larvae and the number of live larvae per plant varied significantly across treatments and spray rounds, with the control plants experiencing the most severe damage and the highest larval counts.

An important finding was that Ampligo 150 ZC-treated plants consistently showed the lowest leaf damage and larval survival across all rounds. Especially at 5 mL/10L and 7.5 mL/10L doses,

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suggesting high efficacy of this formulation. The sustained reduction in damage in subsequent spray rounds further suggests potential residual activity of Ampligo 150 ZC. While Match 050 EC showed some effectiveness, its performance was inconsistent, particularly at higher doses during later spraying rounds.

These findings are in agreement with prior studies, such as (Sisay et al., 2019), who reported that synthetic insecticides significantly reduced Fall armyworm damage and larval populations compared to untreated plants. Similarly, research in the Americas (Andrews, 1988; Foster, 1989) shows that synthetic insecticides remain an essential component of Fall armyworm management in maize during both vegetative and reproductive stages.

Nevertheless, reliance on synthetic insecticides comes with challenges. In countries like Somalia, the risk to human health due to improper handling and the lack of personal protective equipment is a major concern (Day et al., 2017). Furthermore, the threat of resistance development, as documented in native Fall armyworm populations (Yu, 1991), highlights the necessity for integrated pest management approaches. The repeated application of synthetic insecticides, though effective for managing *S. Frugiperda*, poses significant environmental and resistance-related risks. Prolonged use of chemical pesticides has been shown to contaminate soil and water resources, reduce biodiversity, and harm non-target organisms, including beneficial insects and aquatic species (Abhilash & Singh, 2009).

The study’s findings have significant implications for research, agricultural practice, and policy. For research, the proven efficacy of Ampligo 150 ZC calls for further studies on optimal dosages, resistance management, and environmental impacts, as well as economic and yield benefits. However, maize yield data were not collected in this study due to unexpected field damage caused by wild pigs, which destroyed the maize crop just before the harvest. However, we have now explicitly stated this as a key limitation in the conclusion and have proposed it as a major focus for future studies.

In practice, Ampligo 150 ZC at 5-7.5mL/10L is recommended for effective Fall armyworm control in smallholder maize systems, emphasizing the need for farmer training on safe and proper usage. From a policy perspective, there is a need for coordinated actions by national institutions such as the Ministry of Agriculture and Irrigation and the Somali Agricultural Regulatory and Inspection Services (SARIS) should regulate the safe use, distribution, and disposal of synthetic insecticides. Moreover, integrated pest management (IPM) strategies include intercropping and crop rotation, and the use of biopesticides derived from Bacillus thuringiensis (Bt) and the neem-based products and biological control agents like *Telenomus remus* and *Trichogramma spp* should be promoted to reduce chemical dependency and resistance risk (Ahissou et al., 2021). A coordinated approach

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among researchers, practitioners, and policymakers is essential for sustainable Fall armyworm management and improved food security.

5. CONCLUSION

The current study aimed to evaluate the effectiveness of two selected synthetic insecticides with each containing three different dose levels, in controlling the Fall Armyworm infestation in the maize crop in Afgoi district, Somalia. The most obvious findings to emerge from this study are that non-treated control maize plants experienced the highest levels of leaf damage and live larval counts, whereas Ampligo 150 ZC-treated plants, particularly at 5 and 7.5 mL/10L-showed superior performance in minimizing Fall armyworm impact.

While both Ampligo and Match insecticides had insecticidal effects, Ampligo 150 ZC demonstrated more consistent efficacy across all application rounds, both in terms of reducing foliar damage and suppressing larval survival. No statistically significant differences were detected among Ampligo treatments at different doses, including that even lower doses may be sufficient, although further testing is needed. The findings highlight the potential of Ampligo 150 ZC as a preferred option for Fall armyworm control in Maize. Building upon the findings of this research, future studies should consider incorporating yield and cost-benefit analysis to assess the economic viability of various insecticide treatments. It is also to investigate the long-term effects of repeated synthetic insecticide use, particularly concerning resistance development in the Fall armyworm populations. Furthermore, future research should explore how Ampligo 150 ZC can be effectively integrated into broader integrated pest management strategies, including the use of biological control agents and sustainable agronomic practices. And also, to enhance the reliability and applicability of findings, we recommend that future research be conducted across multiple cropping seasons to capture variability in climate conditions and pest dynamics.

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