World Journal of Environmental Biosciences
Available Online at: **www.environmentaljournals.org**

Volume 14, Issue 3: 49-55

https://doi.org/10.51847/fGwGFN5SeX

ISSN 2277- 8047

Management of *Diuraphis noxia* (Hemiptera: Aphididae) Using Bio-Intensive and Chemical-Intensive Seed Treatments in Ambo, Ethiopia

Bekele Tessema[1], Tadele Shiberu[1]*

[1]Department of Plant Sciences, School of Agriculture, Ambo University, Guder Mamo Mezemir Campus, Ambo, Ethiopia.

ABSTRACT

For a large percentage of the world's population, wheat is an essential cereal crop and their main food supply. Various insect pests also provide a challenge to its production. One of the most destructive aphid pests in wheat-growing regions is the Russian wheat aphid, Diuraphis noxia. Three replications and a randomized complete block design were used to set up the experiment. Prior to sowing, the wheat seed was treated with three chemical pesticides and botanical seed treatments. The results showed that the total number of Russian wheat aphid nymphs and adults per leaf, plant, panicle seeds/plant, panicle length, plant height, number of tillers per plant, date of Russian wheat aphid observation, date of 50% flowering, and date of maturity were all significantly (P≤0.05) different from the untreated check. These tests demonstrated that at the vegetative stage, there was a low number of aphids in the treatment plots recorded, but in the untreated control, a significant number of aphids was recorded. Gaucho Evo FS 275, Gaucho Flexx FS 600, and Pro Seed plus 63 WS all those chemical seed treatments control the Russian wheat aphids from wheat when compared to treatments.

Keywords: *Bio-intensive, Botanicals, Chemical-intensive, Russian wheat aphids, Seed treatment*

Corresponding author: Tadele Shiberu
e-mail ✉ s1978tade@gmail.com
Received: 20 April 2025
Accepted: 19 August 2025

INTRODUCTION

One of the principal cereal crops farmed in Ethiopia is wheat (Triticum spp.), which is typically rain-fed but has lately been irrigated by subsistence farmers. It is one of Ethiopia's most important annual crops in terms of both its contribution to direct human consumption and its percentage of the country's overall planted cereal land. It makes up 3.0% of the GDP and 13.7% of the value contributed in agriculture (Anonymous, 2008). Even while wheat offers several benefits in our nation, there are also various obstacles to its cultivation. From seeding to harvesting, these factors include a variety of biotic and abiotic stressors, including heat, drought, disease, and insects. Russian wheat aphids are a serious pest of wheat and one of the most recent and significant pests of tiny grains (Shea *et al*., 2000). The entire life cycle of this species, Diuraphis noxia (Mordvilko), is devoted to grains and grasses. It is a significant pest in all of Ethiopia's wheat-growing regions, particularly those at elevations above 2,500 meters above sea level, where wheat is grown year-round as the primary food crop (Alemu *et al*., 2014). From the vegetative stage to the period of milk development, it feeds on the effective blades and spikes. Honeydew excretions coating blade surfaces interfere with plant respiration and photosynthesis in years with high aphid outbreaks, leading to a considerable reduction in production (Zhi *et al*., 2023).

This bug prefers barley and wheat, but when the primary crops mature or are unavailable, they can graze on grass species. Shortly after they start feeding, Russian wheat aphids are said to prefer to reside in tightly coiled leaves and leaf whorls. RWA prefers wheat as one of its hosts. In recent years, there have been severe infestations on leaves, stems, awns, and heads, resulting in necrosis and blackening of these areas. The intensity of rolling ranges from a simple folding of the leaf along the mid-vein to one side of the leaf rolling in on itself to the entire leaf. According to Sedighi *et al*. (2012), Russian wheat aphids are among the most damaging aphid pests that can reduce individual plant production by 90% when wheat is planted on dry terrain (Alaghemandan *et al*., 2022; Chidambaranathan & Culathur, 2022; Abdulrahman *et al*., 2023).

It is a significant pest in all of Ethiopia's wheat-growing regions, particularly those above 2,500 meters above sea level, where wheat is grown year-round as the primary food crop (Alemu *et al*., 2014). It is a highly polyphagous pest that targets a variety of plant species, including commercially significant and widely produced crops (Tesfaye, 2003). The percentage of infected leaves, panicles, and tillers is directly correlated with lower production in Ethiopia, and the length of the infestation may be more important in causing harm to the host plant. According to Turanli *et al*. (Turanli *et al*., 2012), rising aphid infestation was linked to a decrease in grain yield (7.9 to 34.2%). Tesfay (2003) also noted that as infection intensity grew, there was a significant decrease in wheat grain production (68%) and biomass (55%), as well as delayed heading and maturity. The majority of management strategies, including host plant resistance, biological control, and chemical control (Fritea *et al*., 2023) techniques against RWA, have been investigated independently in various regions and times (Hatting *et al*., 2004;

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Alemu *et al*., 2014). A number of problems, including resistance, environmental contamination, and a decrease in natural enemies, have resulted from the use of these insecticides (Chen, 2015; Akbari, 2023; Mohammad *et al*., 2024). Therefore, in order to control wheat aphids, a better management approach must be developed. Therefore, there was no data regarding how well seed treatments worked in conjunction with other RWA management strategies. Thus, this study's main goal was to develop chemical and botanical seed treatment strategies for controlling Russian wheat aphids on wheat.

MATERIALS AND METHODS

Description of the study area

This study was conducted in the West Shoa Administrative Zone of the Oromia Regional State, on the main campus of Ambo University, during the 2022–2023 cropping season under irrigation. Ambo, which is about 114 kilometers west of Addis Ababa, is renowned for having perfect living conditions. Ambo experiences four distinct seasons, just like many other places in Ethiopia: spring, winter, summer, and fall. at 2,100 meters above sea level, with an average yearly temperature of 18.9°C and 1,120 mm of precipitation. A variety of crops can be grown with ambo. It is composed of a mixture of different soil types, and it is used for cultivating different crops. The Ambo University geographically lies at 370 844778 0 E longitude and 80 9822350 N.

Procedures for botanical seed treatment, collection, and preparation

The procedures for botanical seed treatment collection and preparation were done as follows: First of all, two botanicals will be evaluated as a seed treatment. These two fresh leaves of Vernonia amygdalina del and Croton macrostachyus were removed, gathered, and concurrently separated from any disease or insect infection before being cleaned and chopped into tiny pieces. The following steps were used to prepare the botanical preparation and extraction in accordance with the method outlined by Stoll *et al.* (2000): In this procedure, 250 g of fresh botanicals were chopped and strained in a grinder. The chopped parts of botanicals were soaked in 1 L of distilled water for 1 day. Both botanicals would be ground, mixed, strained, and filtered through cheesecloth. Finally, the filtered botanicals through cheesecloth were treated with wheat seeds as soon as the seeds were treated with botanicals.

Treatments and experimental design

The field was being plowed using manpower and harrowed manually to bring the soil to fine tilth. Each plot measured 1.5 m in width and 2 m in length (3 m^2), with 0.50 m between plots and 1 m between blocks. The total area being planted was 99 m^2, with 33 plots, and a total area of 132 m^2 was required. Wheat used as planting material was being sown 5 cm deep on prepared beds in rows per plot at a spacing of 10 cm between rows and drill planting. There were fifteen rows per plot and drill sowing per row. On the date of sowing, fertilizer NPS was applied at a rate of 100 kg/ha. According to each plot's recommendation, the other crop management techniques were being applied consistently (Szklener *et al*., 2023). Throughout the season, all agronomic procedures were carried out. The Danda seed. Midway through February, a cultivar was grown during the off-season (irrigation) at the Ambo main campus. Three replications using a randomized complete block design (RCBD) were used to set up the experiment. Prior to sowing, the wheat seed was treated with three chemical insecticides (Gaucho Evo FS 275, Gaucho Flexx FS 600, and Pro Seed plus 63 WS), botanical seed treatments (Croton macrostachus and Vernonia amygdalina Del), and a combination of these chemical insecticides and botanicals at three different rates. When the bug was seen on the plant, 5% EC was administered. Russian wheat aphids were observed at various phases of the plants after they germinated, and the amount of aphid infestations per plant was tracked until harvest. The field was monitored regularly for the protection of wild animals, insects, and disease problems.

Sampling procedure

In this study, the primary data collection technique was employed. The first stage was the purposive selection of wheat growing in the field by tagging each of them with a rope. Five plants were randomly selected and tagged in each plot. The selection of the wheat to be included in the sample was done using a diagonal random sampling technique, taking five plants from each plot. This can be seen with a 10x magnification hand lens within one week through direct observation of the field and counting the insects using the hand lens and the naked eye. The data was collected from the selected plants earlier randomly.

Data collection

Five plants were chosen at random and tagged in each plot during the initial phase. We counted and documented the number of nymphs and adults/leaves, the number of nymphs and adults/panicles, and the total number of panicles and tillers per plant (Falko & Naumenko, 2023; Benhmida & Trabelsi, 2024). Additionally, the number of plants per plot, the days to 50% flowering, the date of planting and germination, and the date Russian wheat aphids were noted. Additionally noted were days to maturity, plant height (cm), panicle length (cm), seeds/plant, and yield statistics.

Number of nymphs and adults per leaf

The total number of nymphs and adults per leaf was collected from treated and untreated checks at seven-day intervals. The data was collected by using the 10x magnification hand lens and observation by the naked eye within one week.

The total date of 50% flowering: The total date of 50% was collected from treated and untreated check wheat plants every day. The data collection was started 45 days after sowing with the treated and untreated wheat plants until they arrived at 50% flowering (Al Abadie *et al*., 2023; Atrushi *et al*., 2023). The data collection was collected by using the 0.5m x 0.5m quadrant. While taking the data, the quadrant was put in the plot, and the number of flowered and non-flowered per quadrant was counted and recorded. Finally, calculate the number of flowers by using the following formula.

$$\text{50\% Flowering Percentage} = \frac{\text{Number of flowers per quadrant}}{\text{Total number of plants per quadrant}} \times 100 \qquad (1)$$

Total number of nymphs and adults per panicle

The total number of nymphs and adults per panicle was collected from treated and untreated check wheat plants with intervals of seven days. The data collection started immediately after the plant started flowering.

Number of tillers per plant

The number of tillers per plant was collected from treated and untreated check wheat plants only once. The data collection was taken after the plant had flowered. The number of tillers was counted from the five plants that were tagged earlier. The data was collected once only by using our naked eyes.

Plant height

The plant height was collected from treated and untreated check wheat plants. The data was taken only once. The data collection was taken after the plant was mature. The data was taken by using our naked eyes and a meter. The plant height was measured by a meter and recorded as soon as it was measured.

Date of maturity

The date of maturity was collected from treated and untreated wheat plants after the plant was totally mature. The data was taken only once. The data collection was taken after the plant was totally mature. The data was taken using our naked eyes.

Data analysis

The Generalized Linear Model (GLM) procedure of SAS software version 9.4 (SAS, 2013) will be used to analyze the collected data, and the Gomez and Gomez (1984) procedure will be followed for interpretation. The least significant difference test (LSD) at a 5% level of significance was used to separate the differences between means.

RESULTS AND DISCUSSION

Germination test

The laboratory result indicated in **Figure 1** that the chemical insecticides (Gaucho Evo FS 275, Gaucho Flexx FS 600, and Pro Seed Plus 63 WS), botanical insecticides (*C. macrostachyus* and *V. amygdalina*), and the combination of the chemicals and botanicals had no significant ($P \geq 0.05$) differences among the treatments. In all treatments, there was no difference in germination percentage observed in the seed that was treated with chemicals (Gaucho Evo FS 275, Gaucho Flexx FS 600, and Pro Seed Plus 63WS). The germination percentage and date of germination results showed that *C. macrostachus* and *V. amygdalina* at 5 days, 79.7-81%, were germinated, while the seeds that were treated with chemicals (Gaucho Evo FS 275 and Gaucho Flexx FS 600) at 6 days, 82-84%, and the combinations of chemicals and botanicals (Gaucho Evo FS 275 + Croton macrostachus, Gaucho Flexx FS 600 + Croton macrostachyus, Gaucho Evo FS 275 + 275+Vernonia amygdalina del, and Gaucho Flexx FS 600 + Vernonia amygdalina del) at 6 days, 80-81%, germinated.

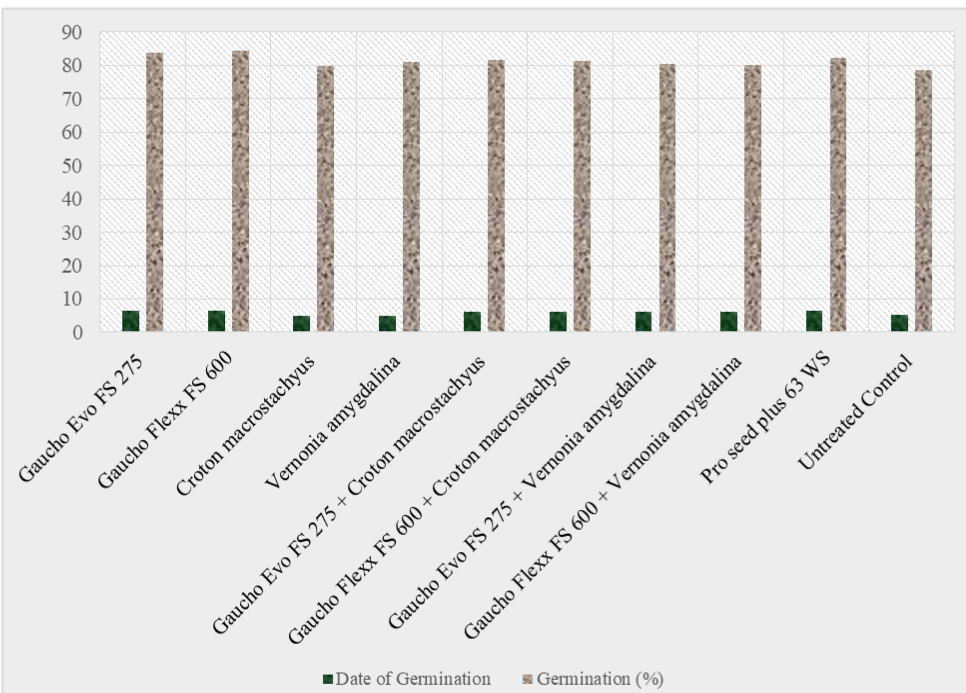

Figure 1. Effect of chemical-intensive and bio-intensive on date of germination and percentage of germination Test

The effectiveness of chemical-intensive and bio-intensive

The total number of nymphs and adults of Russian wheat aphids per leaf

The total number of Russian wheat aphid nymphs and adults per leaf demonstrated a substantial ($P < 0.05$) difference higher than that of the untreated control, as shown in **Table 1**. Gaucho Evo FS 275, Gaucho Flexx FS 600, Pro Seed Plus 63 WS, and Range 5% EC showed low Russian wheat aphid infection per leaf; the remaining plants were approved as the untreated check. The seeds that were treated with chemicals (Gaucho Evo FS 275, Gaucho Flexx FS 600, and Pro Seed plus 63), the combination of chemicals and botanicals, had a low infestation of aphids at any stage. According to a study done in the lab, imidacloprid seed treatments dramatically decreased the survival rates of four Russian wheat species (Zhang *et al*., 2016; Zhi *et al*., 2023). On the other hands, the untreated check, *V. amygdalina*, and *C. macrostachyus* were highly infested with aphids. According to **Table 1**'s ANOVA result, C. macrostachyus, V. amygdalina, and the untreated check were more susceptible to Russian wheat aphid damage to wheat in field settings. In the untreated check, the consequences of the Russian wheat aphid infestation were first observed during a vegetative stage.

Due to the Russian wheat aphids' preference for feeding on rolled leaves in the upper portions of the plants, there is less photosynthetic area, which lowers biomass production and, ultimately, yields. The untreated check and bio-intensive seed treatment plots had more nymph and adult aphids per leaf, which caused the plants to roll their leaves more.

Table 1. Effect of chemical-intensive and bio-intensive on the total number of nymphs and adults per leaf.

Treatments	Total no. of nymph per leaf	Total no. of adult per leaf
Gaucho Evo FS 275	0.55^{c}	0.43^{ed}
Gaucho Flexx FS 600	0.52^{c}	0.35^{ed}
Croton macrostachyus	1.62^{a}	1.29^{a}
Vernonia amygdalina	1.51^{a}	1.13^{a}
Gaucho Evo FS 275 + *Croton macrostachyus*	1.15^{b}	0.73^{bcd}
Gaucho Flexx FS 600 + *Croton macrostachyus*	1.05^{b}	0.75^{bcd}
Gaucho Evo FS 275 + *Vernonia amygdalina*	1.07^{b}	0.62^{bcde}
Gaucho Flexx FS 600 + *Vernonia amygdalina*	1.05^{b}	0.81^{cb}
Pro seed plus 63	0.57^{c}	0.52^{cde}
Range 5% EC	0.67^{c}	0.48^{cde}
Untreated Control	1.83^{a}	1.61^{a}
CV (%)	17.9	26.8
MSE ±	0.56	0.44
LSD at 0.05	0.31	0.35

Note: Means with the same letter(s) in the columns are not significantly different for each other

All treatment effects were significant at p≤0.05 least significance difference (LSD)

The difference between chemical-intensive and bio-intensive seed treatments concerning nymphs and adults increased from the vegetative observation to the maturing stage, where more nymphs and adults were observed on bio-intensive seed treatment. Hence, *C. macrostachyus* and *V. amygdalina* controlled the aphids for 46-49 dates, while Gaucho Evo FS 275, Gaucho Flexx FS 600, and Pro Seed Plus 63WS controlled the aphids for 76-90 dates, and their combination controlled the aphids for 56-60 dates. In a similar vein, Pike *et al*. (1993) and Nematollahi (2017) found that the seed dressing treatment could keep aphids under control for 27–85 days and that the plants grown from the treated seed suffered less than 2 percent harm. According to Ahmed *et al*. (2001), their seed dressing is more beneficial than a standard spray. The current findings are consistent with research by Burd *et al*. (1996) on the impact of aphid damage on plant growth from imidacloprid-treated seeds, which protected plants 45 days after sowing; Ahmed *et al*. (2001) found that imidacloprid combined with tebuconazole could control aphids for eight weeks when applied as a seed treatment.

The total number of nymph and adult Russian wheat aphids per plant

As demonstrated by the ANOVA. The total number of Russian wheat aphid nymphs and adults per plant was considerably (P≤0.05) more than the untreated control, according to **Table 2**. Because botanicals were not transferred from the root zone to the above-ground portions of the plants, a high infestation of Russian wheat aphids per plant was seen in both untreated and botanical seed treatments. Due to this reason, botanical seed treatments were more vulnerable to the Russian wheat aphid damage under field conditions from the vegetative stage to the maturing stage, while Gaucho Evo FS 275, Gaucho Flexx FS 600, and Pro Seed Plus 63WS were systemic chemicals that controlled aphids from feeding on plants. Those chemicals were transmitted from the root zone to all above parts of the plants through xylem. Range 5% E.C. was applied directly on plants when the aphids observed on the plants directly contact it when the insect injects plant parts. The combination of bio-intensive and chemical-intensive had somewhat low infestation because even if botanicals were not systemically transmitted when they combined with chemicals (Gaucho Evo FS 275, Gaucho Flexx FS 600), the combination transmitted from the root zone to above-ground parts of the plants. As a result, the treated and untreated tests differed significantly in every treatment **(Table 2)**.

The chemical-intensive seed treatments controlled the aphids more than the other seed treatments. The study's findings demonstrate that Russian wheat aphids cause damage to growth and development characteristics, which manifests as symptoms on the leaves. Early observations showed that the plants in the chemical-intensive seed treatment plots were more affected, as seen by the larger disparities in plant height between infested and non-infested plants. However, the bio-intensive seed treatment plots showed larger disparities in plant height in the final observation.

Because infestation caused more leaf rolling under the untreated check, there was a substantial interaction between the two. According to Liu *et al*. (2001), leaf rolling typically results in less photosynthetic area, which lowers biomass production and, ultimately, yields. The botanical seed treatment plots had more leaf rolling, which resulted in a higher number of aphids per plant. Aphid assaults seem to cause the biggest loss in terms of seed set reduction. This result is consistent with the findings of multiple researchers (Adisu *et al*., 2003; Nematollahi, 2017) and/or significantly affects grain quality (Ahmed *et al*., 2001; Nematollahi, 2017), who reported that the most frequent cause of yield loss due to insect pests was a decrease in grain weight. They also reported that early, severe damage to wheat can result in total crop loss and significantly affect grain quality.

Gaucho Flexx FS 600 matured at 121 days, and it had a 129 cm height, while the uncontrolled matured at 90 days and had a 57 cm height. As the study figure indicated, the plant that was not affected by aphids had a normal maturity date and long plant height. This outcome supported earlier research by Addisu *et al*. (2003) and Babar *et al*. (2018), which found that the insecticides successfully controlled the aphids and that the plants grew to their typical height.

Table 2. Effect of chemical-intensive and bio-intensive on the total number of nymphs and adults of Russian wheat aphids per plant.

Treatment	TNNP	TNAP
Gaucho Evo FS 275	0.7ᵈ	0.61ᵉᶠ
Gaucho Flexx FS 600	0.58ᵈ	0.48ᶠ
Croton macrostachyus	2a	1.81ᵃ
Vernonia amygdalina	1.72ᵃ	1.61ᵃ
Gaucho Evo FS 275 + *Croton macrostachyus*	1.4ᵇ	1.027ᶜ
Gaucho Flexx FS 600 + *Croton macrostachyus*	1.28ᶜᵇ	1.023ᶜ
Gaucho Evo FS 275 + *Vernonia amygdalina*	1.23ᶜᵇ	0.91ᶜᵈᵉ
Gaucho Flexx FS 600 + *Vernonia amygdalina*	1.28ᶜᵇ	1ᶜᵈ
Pro seed plus 63ws	0.82ᵈ	0.67ᵈᵉᶠ
Range 5% EC	0.9ᶜᵈ	0.75ᶜᵈᵉᶠ
Untreated Control	2.2ᵃ	1.85ᵃ
CV (%)	18.9	19.5
MSE ±	0.75	0.63
LSD at 0.05	0.401	0.35

Note: Means with the same letter(s) in the columns are not significantly different for each other

All treatment effects were significant at p<0.05 least significance difference (LSD)

TNNP: total nymph number per plant, TNAP: Total number of adults per plant

The total number of nymph and adult of Russian wheat aphids per panicle

According to the subsequent study, there were significant (P≤0.05) differences between the total number of nymphs and adult Russian wheat aphids per panicle and the untreated check. C. macrostachyus, V. amygdalina, and the untreated check had the highest infestation. Hence, botanical seed treatments are more susceptible to the Russian wheat aphids during the growing period from the vegetative to the mature stage, while the seed that was treated with chemicals, a combination of chemicals and botanicals, and Range 5% EC as foliar application had low infestation **(Table 3)**.

Table 3. Effect of chemical-intensive and bio-intensive on the total number of nymphs and adults of Russian wheat aphids per panicle

Treatment	Toal no. of nymph/ panicle	Totalno. of adult/ panicle
Gaucho Evo FS 275	0.83ᶠ	0.8ᶜ
Gaucho Flexx FS 600	0.8ᶠ	0.78ᶜ
Croton macrostachyus	2.0ᵇ	1.9ᵃ
Vernonia amygdalina	1.8ᶜᵇ	1.56ᵇ
Gaucho Evo FS 275 + *Croton macrostachyus*	1.4ᵈ	1.08ᶜ
Gaucho Flexx FS 600 + *Croton macrostachyus*	1.5ᶜᵈ	1.13ᶜ
Gaucho Evo FS 275 + *Vernonia amygdalina*	1.35ᵈᵉ	1.126ᶜ
Gaucho Flexx FS 600 + *Vernonia amygdalina*	1.47ᶜᵈ	1.23ᶜ
Pro seed plus 63	1.03ᶠ	1.01ᶜ
Range 5% EC	1.05ᵉᶠ	1.0ᶜ
Untreated Control	2.5ᵃ	2.0ᵃ
CV (%)	14.6	16.99
MSE±	0.8	0.53
LSD at 0.05	0.35	0.36

Note: Means with the same letter(s) in the columns are not significantly different for each other All treatment effects were significant at p≤ 0.05, least significant difference (LSD)

Number of tillers per plant

Figure 2 shows substantial variations in the number of tillers per plant (P < 0.05) compared to the untreated check. Wheat seeds treated with pesticides or a mixture of chemicals had a high number of tillers per plant, whereas the remaining treatments had a low number of tillers per plant. Due to the Gaucho Evo FS 275, Gaucho Flexx FS 600, Pro Seed plus 63 WS, and the combination of botanicals with Gaucho Evo FS 275 and Gaucho Flexx FS 600, the Russian wheat aphids were controlled in the plant. At the initial time, the seed that was treated with chemicals and the combination of botanicals with chemicals produced good plant performance, and through time this good plant performance produced more tillers, while botanicals and untreated checks had a low number of tillers as compared to chemical-intensive treatments **(Figure 2)**.

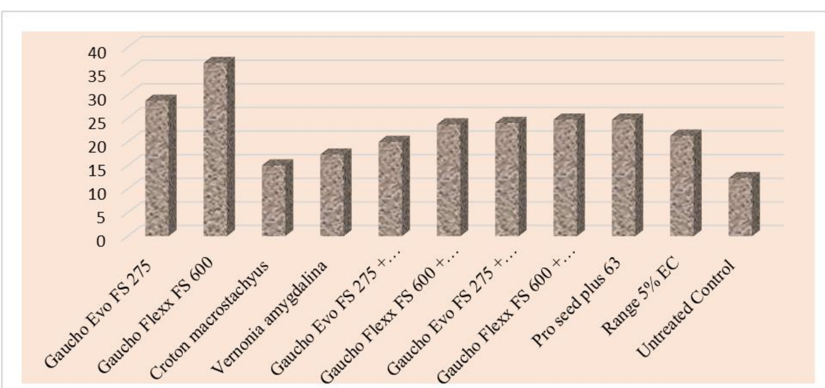

Figure 2. Effect of chemical-intensive and bio-intensive on the number of tillers per plant

Effect of chemical-intensive and bio-intensive insecticides on yield and yield components of wheat

The table below shows a substantial ($P < 0.05$) difference in the overall date of 50% flowering compared to the untreated check. The seeds that were treated by Gaucho Evo FS 275, Gaucho Flexx FS 600, and Pro Seed Plus 63 WS showed a late date of 50% flowering. While plants with low infestations of aphids produced more tillers and had good plant performance, this led to a long time to flower. At the same time, *C. macrostachyus* and *V. amygdalina* had higher infestation levels as compared to those mentioned above. Range 5% E.C. was applied directly when the aphids were observed on the plants because the aphids released toxic chemicals to the plant body parts before the chemical was sprayed, leading to stunting and deforming the plants, which reduces the photosynthesis of the plant that results in a moderate date of 50% flowering. Hence, in all treatments, there were significant differences between botanicals, the untreated check, and chemicals. The seeds that were treated with a combination of chemical-intensive and bio-intensive had a moderate 50% flowering **(Table 4)**.

Table 4 shows a significant ($P < 0.05$) increase in plant height and maturity date compared to the untreated control group. The longest date of maturity and the highest plant height were observed in Gaucho Flexx FS 600. Hence, the plants that had low infestation levels had good plant performance, which led to a longer time to mature and a longer plant height, while the remaining plants were somewhat infested by aphids, which decreased the date of maturity and plant height. The seeds that were treated with the Gaucho Evo FS 275, Pro Seed Plus 63WS, a combination of chemical-intensive and bio-intensive insecticides, had a moderate date of maturity and plant height, whereas the untreated check had a low date of maturity and short plant height. Concerning the yield of the findings shown in **Table 4**, the chemical-intensive and the combination of both gave higher yields than the bio-intensive and the untreated check. While the bio-intensive significant ($P < 0.05$) difference is higher than the untreated check.

Table 4. Effect of Chemical-intensive and Bio-intensive insecticides on yield and yield components of Wheat

Treatment	Flowering date (50%)	Date of Maturity	Plant Height (m)	Yield/ha (tons)
Gaucho Evo FS 275	74.3^{ab}	103.3^{b}	1.11^{b}	3.478^{a}
Gaucho Flexx FS 600	78.7^{a}	121.3^{a}	1.29^{a}	3.418^{a}
Croton macrostachyus	56^{e}	94.0^{b}	0.52^{h}	2.688^{b}
Vernonia amygdalina	60^{de}	97.7^{b}	0.61^{fgh}	2.712^{b}
Gaucho Evo FS 275 + *Croton macrostachyus*	70.3^{c}	103.3^{b}	0.7^{edf}	3.055^{b}
Gaucho Flexx FS 600 + *Croton macrostachyus*	71.7^{c}	97.0^{b}	0.82^{ed}	3.144^{ab}
Gaucho Evo FS 275 + *Vernonia amygdalina*	70.7^{c}	102^{b}	0.75^{efg}	3.367^{a}
Gaucho Flexx FS 600 + *Vernonia amygdalina*	71.3^{c}	92.0^{b}	0.96^{cb}	3.091^{a}
Pro seed plus 63	72.7^{abc}	102.4^{b}	1.10^{b}	3.255^{a}
Range 5% EC	67^{bcd}	101.3^{b}	0.89^{cd}	3.375^{a}
Untreated Control	54.3^{def}	90.7^{bc}	0.57^{gh}	2.255^{c}
CV (%)	10.2	10.37	14.5	1.633
MSE ±	284.5	3.58	0.34	1.04
LSD at 0.05	9.1	17.3	0.17	0.57

Note: Means with the same letter(s) in the columns are not significantly different for each other

All treatment effects were significant at $p<0.05$, least significant difference (LSD)

CONCLUSION

The present study of chemical and botanicals seed treatments would prove that the Russian wheat aphids were potentially controlled in the Gaucho Evo FS 275, Pro Seed Plus 63WS, Gaucho Flexx FS 600, *C. macrostachyus* and *V. amygdalina* seed treatments, which were systemic insecticides. Among those chemicals, seed treatments applied in the experiment to control the Russian wheat aphids Gaucho Flexx FS 600 is one of the most highly controlled at removing the *D. noxia* from the plant when compared with other treatments, and it produced a greater number of tillers per plant, seeds per plant, and yields. Both botanicals, the combination of chemicals and botanicals, controlled the aphids at the early stage, but they were not effective in controlling aphids at the later stage, while the untreated check had a significantly higher score of total number of nymphs and adults per leaf, plant, and panicle; early flowering and maturity; short plant height and panicle length; and a low number of tillers, seeds/plants, and yields per plant. Therefore, the farmers and the researchers proved that are used as seed treatments for the management of *D. noxia* gave interesting reliable management of wheat aphids in wheat growing areas of Ethiopia. Further, the researchers investigate the effect of these products on non-target organisms at different ecologies of Ethiopia.

ACKNOWLEDGMENTS: Authors thank the Ambo University for providing Experimental field for this study.

CONFLICT OF INTEREST: None

FINANCIAL SUPPORT: None

ETHICS STATEMENT: None

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