

Efficacy of Azadirachtin 0.1% on the Management of Jassids *Emrasca biguttula* in Cotton

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ABSTRACT

Cotton is an invaluable crop to many countries in the world. It provides raw materials in the textile industry. It is also important to oil expressers and livestock feed makers. In Zimbabwe it is a source of foreign currency to the state and income to many. Many factors, which include susceptibility to attack by sucking and chewing insect pests, has led to low productivity of cotton. Jassid, a sucking pest, is a major threat to cotton. Jassid infestation leads to significantly lower amounts of yield with a degraded quality of fibre, creating problems when processing lint. An experiment to evaluate the efficacy of Azadirachtin 0.1% EC, a biopesticide against jassid in cotton, was conducted at Cotton Research Institute (CRI) in Kadoma, for two seasons (2022/23 and 2023/24) in Zimbabwe. The trial was laid out in a Randomized Complete Block Design (RCBD) with six treatments, which included a no control, four doses of Azadirachtin 0.1% EC at 300ml/ha, 500ml/ha, 750ml/ha, and 1125ml/ha, Dimethoate 40EC at 250ml/ha (control). The gross plot was 6 rows x 8m = 48m² and the sampling area was 4 rows x 6m = 24m². Measurements were jassid counts, jassid damage, and predator counts. Data not normally distributed was transformed using the square root of (x+3/8). Data analysis was done using GenStat 14th Edition. Test chemical Azadirachtin 0.1% EC ($P<0.005$) showed a comparable performance with the standard treatment Dimethoate 40EC on jassid control at all rates. All rates of Azadirachtin were statistically similar to the standard check ($P<0.005$). The control treatment had statistically higher jassid populations (24.94) than all the Azadirachtin rates. Azadirachtin 0.1% EC was recommended for registration for control of cotton jassids in Zimbabwe at a rate of 500ml/ha.

Keywords: Jassids, Azadirachtin 0.1% EC, Dimethoate 40EC, predators

1. Introduction

Cotton is a vital crop, serving as a major source of natural textile fibres and accounting for about 25% of global fibre consumption [17]. In Zimbabwe cotton production is driven by high demand for cotton fibre, which is a key raw material for the textile and clothing industry, as well as the food and animal feed sectors. Cotton production is hindered by both environmental factors like adverse climate conditions and biological factors including inadequate suitable varieties and significant damage from the pests [2].

Cotton crops suffer significant damage from sucking and chewing insects throughout their growth stages, from seedlings to harvest, ultimately reducing both yield and quality. Jassids pose a significant threat to cotton crops, being one of the most damaging sucking pests in major cotton growing regions worldwide, including Zimbabwe [3]. Jassids severely impact cotton crops during their early growth and reproductive stages. Both adult jassids and their nymphs feed on the sap cotton plants, extracting it from twigs and leaves, and inject toxins that impair photosynthesis, nutrient transport, water uptake, and overall plant growth [11]. Infested leaves typically curl downwards, turning yellow, then red and eventually dry out and drop off. [9] Severe infestations can stunt young plants and cause hopper burn, a condition that damages the plant's ability to produce fruit, ultimately reducing crop yield. Infested plants yield significantly less cotton and the fibre quality is compromised, causing issues with lint processing. Jassid infestation is estimated to cause a 19% loss in cotton yield [10]. Varieties which are tolerant to jassid attack, play a very important role in cotton production when managing the jassids and it is also a valuable trait within the Integrated Pest management strategy [8]. Having jassid tolerant varieties will help to reduce the use of chemicals although they are regarded as more effective [7]. There is need for minimal sprays of insecticides and therefore spray application are to be done only after the pest population levels have reached economic damage. It is very important to note that synthetic insecticides are detrimental to the flora and fauna and are not safe to the user and can wipe out all the beneficial insects.

Citation: T. Mtasa, M. Mare, W. Mubvekeri, F. Jimu, and D. Kutwayo (2026). Efficacy of Azadirachtin 0.1% on the Management of Jassids *Emrasca biguttula* in Cotton.

Agriculture Archives: an International Journal.

DOI: <https://doi.org/10.51470/AGRI.2026.5.3.15>

Received on: June 08, 2026

Revised on: July 07, 2026

Accepted on: August 13, 2026

Available Online: September 15, 2026

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Biopesticides are obtained from plant extracts of various tree or grass species and these can be processed to powders for use when spraying [4]. For these we have comprehensive classes ranging from the plant incorporated protectants, microbial pesticides as well as biochemical pesticides. Azadirachtin is a natural pesticide that combines potent neem seed oil extract with other plant-based ingredients, working together to deter insects and disrupt their feeding habits. It acts through both contact and systemic activity. The study aims to assess the effectiveness of Azadirachtin a biopesticide in controlling jassid infestation in cotton crops.

2. Materials and Methods

Experimental Locations and Designs

An investigation on the effectiveness of Azadirachtin 0.1% EC on the control of jassids in cotton was carried out as field trials for two seasons (2022/23 to 2023/24) at Cotton Research Institute in Kadoma, Zimbabwe. It is situated in agro-ecological region 2b at an altitude of 1156m and between 18°19'south and 29°5' east. Maximum temperature experienced in summer is 38°C. Average rainfall is 750-1000 mm.

The trial was laid out in a Randomized Complete Block Design with six treatments replicated four times. The gross plot was 6 rows x 8m = 48m² and the sampling area was 4 rows x 6m = 24m².

Methodology

Weekly counts of jassid and predators were recorded at regular intervals. A jassid economic threshold of 36 or more jassids on 24 scouted plants was used to determine when to spray. Whenever the economic threshold was reached, a spray for controlling jassids using Azadirachtin 0.1% EC was applied at the recommended treatment rates. All other pests were controlled using basing on the economic threshold levels for each pest. A knapsack sprayer with a lance was used for the application of all sprays.

Table 1: Treatment Description

Treatment description	Rate
No control of jassids	
Dimethoate 40 EC	250 ml/ha
Azadirachtin 0.1% EC	300 ml/ha
Azadirachtin 0.1% EC	500 ml/ha
Azadirachtin 0.1% EC	750 ml/ha
Azadirachtin 0.1% EC	1125 ml/ha

Data Analysis

Data analysis was done using GenStat 14th Edition. Mean separation was done using Fisher's Protected LSD at 0.5%. Data which did not follow a normal distribution was transformed using the square root of (a+3/8).

3. Results and Discussion

3.1. Effect of Azadirachtin 0.1% EC on jassid populations

The results revealed highly significant differences ($P < 0.004$) among the treatment means as shown in Table 2. The test chemical Azadirachtin 0.1% EC at all rates (300ml, 500ml, 750ml, and 1125ml/ha) performed statistically similar to the standard dimethoate 40EC (250ml/ha). The control treatment had the highest jassid populations, with a mean count of 24.9,

while Azadirachtin rates had jassid mean counts ranging from 12 to 14. As the dosage rate for Azadirachtin increased, jassid populations were reduced, meaning that the efficacy of Azadirachtin increased as the dosage rate increased.

According to the work done in Pakistan [14], it has been proven that using neem oil can help manage cotton jassids and increase cotton yield while reducing reliance on conventional chemical pesticides and promoting sustainable agricultural practices. Furthermore [12], some other work indicated that half of the recommended doses of popular EPF v12, *B. bassiana*, *M. anisopliae*, and *L. lecani* with botanicals like neem seed oil have been found effective against the sucking pests like jassid. This was in unison with work done in Punjab, India, which also showed that up to 60% jassid mortality with the use of neem extract was very comparable to synthetic insecticides, and similarly, a significant reduction in the jassid population was found with the application of neem oil (33.44%). More so, [6] it has proved that Azadirachtin has shown varying effects on jassid populations. Research has proved that Azadirachtin has relatively low repellence against jassids with a rate of 17.7%. In other contrasting findings [13], it was discovered that other biopesticides like spinomax SC have shown a higher repellence rate against jassids, with a rate of 72.2% highlighting the importance of carefully selecting the most effective biopesticides for managing specific pest populations. However, [1] it has been observed that the use of neem oil was less effective than synthetic (chloropyphos 50%). Other Researchers [5] went on to explain, noting that neem-based products have been seen to affect brood one and pest population levels in the field, including jassid population, and this was revealed in the experiment above, which showed that Azadirachtin at all rates was able to affect jassid populations.

Table 2: Effect of Azadirachtin 0.1% EC on Jassid populations

S. No.	Treatment	Jassids
1	No control of jassids	24.94b
2	Dimethoate 40 EC at 250 ml/ha	12.81a
3	Azadirachtin 0.1% EC @ 300 ml/ha	14.69a
4	Azadirachtin 0.1% EC @ 500 ml/ha	13.62a
5	Azadirachtin 0.1% EC @ 750 ml/ha	13.00a
6	Azadirachtin 0.1% EC @ 1125 ml/ha	12.94a
	Mean	15.33
	P-value	0.004
	S.E.	2.809
	CV (%)	24.2

LSD - Least Significant Differences, CV% - Coefficient of Variation, SE - Standard Error of Differences

Means in a column followed by the same letter are not significantly different ($p < 0.05$)

3.1.2 Effect of Azadirachtin 0.1% EC on predators

The results revealed highly significant differences at ($P < 0.003$) for the ladybird larva and spiders ($P < 0.030$), (Table 3). The first three rates of azadirachtin 0.1% were all statistically comparable to the standard chemical Dimethoate 40EC on the ladybird larva and the highest rate of Azadirachtin 0.1% (1125ml) was statistically comparable to the no control for this predator. As for the spider, the first three levels of Azadirachtin 0.1% were statistically comparable to the standard chemical dimethoate 40EC, however, Azadirachtin 0.1% at 750ml and 1125ml were statistically comparable to the no pesticide applied. Azadirachtin 0.1%EC affected ladybird larvae, and spiders in the same way as Dimethoate 40EC.

Table 3: Effects of Azadirachtin 0.1%EC on predators

Treatment	Ladybird larva	Ladybird adult	Spider
1.No control of jassids	0.7500c	0.437	0.8750c
2. Dimethoate 40EC	0.00a	0.438	0.3125a
3. Azadirachtin @ 300ml	0.1250ab	0.438	0.3125a
4. Azadirachtin @ 500ml	0.2500ab	0.500	0.5000ab
5. Azadirachtin @ 750ml	0.3125ab	0.188	0.5625abc
6. Azadirachtin @ 1125ml	0.4375bc	1.000	0.7500bc
Mean	0.312	0.667	0.552
P Value	0.003	0.104	0.030
LSD	0.172	0.356	0.196
CV%	33.6	5.1	7.2

LSD - Least Significant Differences, CV% - Coefficient of Variation, SE - Standard Error of Differences

Means in a column followed by the same letter are not significantly different ($p < 0.05$)

Note: LL stands for Ladybird Larva, LA stands for Ladybird Adult

Across Season Analysis

Results for the two seasons revealed highly significant differences for the jassids at ($P < 0.001$) and (0.017) for the spider. All rates of Azadirachtin 0.1%EC performed statistically similar to Dimethoate 40EC on jassids control. Azadirachtin 0.1%EC controlled jassids comparably to Dimethoate 40EC. The effect of Azadirachtin 0.1%EC on predators, ladybird larvae, ladybird adults, and spiders was comparable. The test chemical and the standard chemical affected predators in the same manner. The control treatment had the highest predator populations, Table 4.

Table 4: Effect of Treatments on jassids and predators across season 2022 – 24

Treatment	jassids	spider	Ladybird larva	Ladybird adult
1.No control of jassids	24.4b	0.8125b	0.6	0.8
2Dimethoate 40EC	12.2a	0.4271a	0.5	0.8
3 Azadirachtin @ 300ml	13.5a	0.3854a	0.3	0.6
4 Azadirachtin @ 500ml	13.5a	0.5625a	0.5	0.8
5 Azadirachtin @ 750ml	11.6a	0.5729ab	0.9	1.1
6 Azadirachtin @ 1125ml	11.3a	0.6250ab	0.6	1.0
Grand mean	14.4	0.6	0.6	0.8
P Value	<0.001	0.017	0.060	0.496
LSD	2.26	0.14	0.20	0.28
CV%	26.7	29.1	28.7	29.3

LSD - Least Significant Differences, CV% - Coefficient of Variation, SE - Standard Error of Differences

Means in a column followed by the same letter are not significantly different ($p < 0.05$)

Note: LL stands for Ladybird Larva, LA stands for Ladybird Adult

Conclusion

All rates of Azadirachtin 0.1%EC proved to be statistically comparable to the standard chemical dimethoate 40EC in controlling jassids in cotton. Azadirachtin 0.1%EC at 300ml, 500ml, 750ml, and 1125/ha had the same effect on predators as the standard chemical Dimethoate 40EC. Azadirachtin rates 300ml, 500ml, and 750ml/ha and 1125/ha controlled jassids in the same manner as the standard insecticide Dimethoate 40EC.

Recommendation

Azadirachtin 0.1% EC was recommended for registration on control of cotton jassids (*Emrasca biguttula*) in Zimbabwe at the dose rates 500ml/ha.

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