

## **Evaluation of aqueous and powder preparations of Argel (*Solenostemma argel* Del. Hyne.) And Usher (*Calotropis procera* Ait.) against the Green Pit Scale Insect (*Asterolicanium phoenicis* Rao.) (Homoptera: Asterolicanidae) infesting date palm**

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**ABSTRACT:** A field study was carried out at Alghaba Agricultural Scheme, Northern State, Sudan, to investigate the effects of the powder of argel (*Solenostemma argel* Del.Hyne.) and usher (*Calotropis procera* Ait.) on immature stages of the green pit scale insect (*Asterolicanium phoenicis* Rao.). Each plant powder was applied at three dosage rates (1)100 g. powder/ tree as soil dressing, (2)100 g. powder /10 Liter tap water/ tree as spray and (3)100 g. powder as a soil dressing + 100 g. powder /10 Liter tap water for spraying/ tree. The synthetic insecticide Actara 25 W.G. Thimethoxam (Neonicotinoid) was used as a standard insecticide. The results showed that, the plant preparation treatments were effective against the immature stages of the green pit scale insect, and their effectiveness extended for 8-10 weeks after application. Also, most of the plant treatments were comparable to those of Actara in efficiency. However, the cost of the dose / plant (0.0-0.5 SDG) was far less than that of Actara (12.5 SDG). According to the results of this study, Argel and Usher soil treatment (100gm powder / tree) should be recommended as an effective treatment to control the immature stages of the green pit scale insect.

**KEY WORDS:** *Asterolicanium phoenicis*, *Solenostemma argel*, *Calotropis procera*, Alghaba.

### **INTRODUCTION**

Infestation of date palm by the green pit scale insects (*Asterolicanium phoenicis* Rao.) was recorded in Sudan in 1976 at Algolid area in the Northern State (Ali, 1989). The showed that the insect was not indigenous in the country and had been introduced in an infested offshoot of date palm from Saudi Arabia (Ali and Elnaser, 1992). It was first noticed at AlGolid and during the next few years the infestation spread to other areas, South and North of AlGolid, along the Nile banks. The immature and adult females of the scale insect feed by sucking plant sap from all green parts of the palms. They attack the leaflets, leaf rachis and fruits. The attacked green fruits shrink and dry prematurely (Ali and Elnasir, 1992). Losses in date palm production in the

range of 30-50 kg per palm were recorded (Ali *et al.* 1993 ; Idris *et al.* 2006). Also, losses may be as high as 85- 90% depending on severity of infestation, the varietal tolerance and orchard management (Ahmed *et al.* 2001; Ahmed, 2004).

Botanical insecticides have long been proposed as attractive alternatives to synthetic chemical insecticides for pest management; they are reputed to pose little threat to the environment and human health (Isman 2005). More than 1000 species of plants have been reported to have chemicals in leaves, stems, flowers, seeds and roots which possess insecticidal property, but only a few of these have been used for practical insect control on a commercial scale (Badshah *et al.* 2004). The chemical poisons from plants such as

Argel *S. argel* and Usher *C. procera* are mostly alkaloids. Alkaloids are plant products, which are nitrogenous in nature. They are heterocyclic compounds having strong effects on the nervous system of animals and which may result in death (Stoll 2000; Badshah *et al.* 2004).

Various studies were performed on the toxicity of the extracts of argel *S. argel* and usher *C. procera* against several species of insects (e.g.: Ali 2004; Badshah *et al.* 2004; SidAhmed *et al.* 2009 and Hag El Tayeb *et al.* 2009). In the same line, the present study was carried out to study the toxic effects of aqueous and powder preparations of Argel and Usher against the immature stages of the green pit scale insect *A. phoenicis*.

## **MATERIALS and METHODS**

### **The study site:**

Field experiments were conducted in two sites, Gharb Dongola village and Elkinduwa village at Alghaba Agricultural Scheme, northern State. Two applications were applied at each site during the date season of 2007 (e.g. in January and in May). Within each site, 4 rows, each containing 5 date palm trees of similar age, variety Barakawi, were chosen randomly and represented a block. Each date palm tree represented a replicate. The experiments were laid out in a Randomized Block Design (Gomez and Gomez 1984).

### **Preparation of plants aqueous filtrates:**

The argel shoot parts were bought from the local market, and fresh leaves of Usher plant were collected from the College of Agricultural Studies fields at Shabbat. All plants were left to dry for one week at room temperature, and ground by a grinder (Moulinex). The aqueous filtrate of each plant was prepared from a mixture of the plant powder with tap water, stirred manually for 5-10 minutes and was left for 24 hrs.

Then the mixture was filtered through a cotton cloth. All spraying extracts were immediately applied after preparation.

### **Application of treatments**

Five treatments were applied at each site. Three doses of each plant extract: (100 g. powder/ tree as a soil dressing, 100 g. powder /10 Liter tap water/ tree for spraying and 100 g. powder as a soil dressing + 100 g. powder /10 Liter tap water for spraying/ tree) were applied. Each plant powder was added to soil 50 cm away from trunk base and then irrigated. The plants aqueous filtrates were sprayed early in the morning using a knapsack sprayer (SEMCO 14 P.M. / Japan). The synthetic insecticide Actara 25 W.G. Thimethoxam (Neonicotinoid) was applied according to a recommended dose (20 g. / palm) as a soil application (Ahmed, 2006). The control palms were sprayed with water only.

### **Counts of the immature stages of the green pit scale insect:**

Counts of immature stages were made on fortnightly intervals. From each palm, 2 leaflets were randomly detached from each direction i.e., a total of 8. From these, four leaflets were chosen randomly for data collection. An area of 1cm<sup>2</sup> at the base, the middle and the tip of the leaflet was examined under a binocular microscope to calculate the percentage mortality of the immature stages. Any third and / or fourth instar was considered dead when the colour of its scale had been changed from green or yellow to black or brown. If there was any doubt about the death of any stage, its scale can be raised up by a fine pin and by means of an air current, the dead one can be blown out. In case of the living stages, it can be found moving around itself for certain seconds before its mouth parts were released from the leaflet. Pre-spray counts were recorded before treatments application.

**Statistical analysis**

Data was transformed from percentage to arcsine according to Gomez and Gomez (1984). Data was subjected to analysis of variance. Data analysis was done with the aid of MStatC computer program (version 2.10). Means were separated by Duncan's multiple range test at 0.05% confidence limits.

**RESULTS**

Table 1: Mean mortality rate (%) of immature stages of the green pit scale insect at Gharb Dongola (January 2007).

| Treatments         | Mortality % in weeks after application |                     |                     |                     |                     |                      |
|--------------------|--|---------------------|---------------------|---------------------|---------------------|----------------------|
|                    | Pre count                              | 2 <sup>nd</sup> wk. | 4 <sup>th</sup> wk. | 6 <sup>th</sup> wk. | 8 <sup>th</sup> wk. | 12 <sup>th</sup> wk. |
| Untreated Control  | (35)36.25a                             | (33.2)35.16b        | (36.5)37.16C        | (39.8)39.11d        | (41.40)40.00d       | (43.3)41.14d         |
| Argel soil 100g    | (33.3)35.24a                           | (70.3)56.99a        | (74.1)59.42ab       | (75.0)60.01ab       | (69.0)56.18ab       | (46.9)43.14cd        |
| Argel spray 100g   | (34.2)35.81a                           | (71.7)57.87a        | (76.3)60.87ab       | (75.7)60.48ab       | (73.3)58.91a        | (54.1)47.37ab        |
| Argel soil + spray | (36.5)37.18a                           | (72.2)58.17a        | (77.2)61.50a        | (76.7)61.15a        | (72.9)58.62a        | (51.3)45.74bc        |
| Usher soil 100g    | (37.0)37.44a                           | (73.3)58.92a        | (76.3)60.90ab       | (76.6)61.10a        | (71.9)57.98a        | (58.3)49.77a         |
| Usher spray 100g   | (33.5)35.30a                           | (71.3)57.60a        | (70.5)57.13b        | (67.9)55.50c        | (65.5)54.00b        | (48.2)43.94bcd       |
| Usher soil + spray | (39.7)39.06a                           | (75.8)60.52a        | (73.4)58.97ab       | (69.2)56.28bc       | (57.7)49.42c        | (46.9)43.20cd        |
| Actara 25WG 20g    | (33.9)35.62a                           | (73.5)59.03A        | (77.0)61.31ab       | (75.7)60.48a        | (71.1)57.49a        | (50.7)45.42bc        |
| CV%                | 13.3                                   | 5.24                | 5.04                | 5.13                | 4.46                | 6.1                  |
| LSD                | 6.289                                  | 3.77                | 3.734               | 3.772               | 3.125               | 3.551                |
| SE±                | 2.171                                  | 1.301               | 1.289               | 1.302               | 1.079               | 1.226                |

\*Original means are shown within brackets.

\*Means were transformed (arcsine transformations).

\*Arcsine transformed means were separated by Duncans multiple range test at alpha = 0 .05

**Elkinduwa site:**

The results of treatments at this site are shown in table 2. These results showed that, all treatments were effective in the 2<sup>nd</sup> week, but their efficiency became variable during the next period up to the

**First treatment (January 2007):****Gharb Dongola site:**

The results in table 1 showed that all treatments applied were effective from the 2<sup>nd</sup> week up to 8<sup>th</sup> week after treatment with percentage mortality of immature stages significantly higher than those of the untreated control. Also, two of the treatments (e.g. argel spray and usher soil) were still effective up to the 12<sup>th</sup> week.

12<sup>th</sup> week. Only two treatments (e.g. argel soil + spray and Actara) remained effective up to the end of the experiment. Also, higher mortality rates of immature stages were shown by each treatment compared to the control.

Table 2: Mean mortality rate (%) of immature stages of the green pit scale insect at Elikinduwa (January 2007).

| Treatments         | Mortality % in weeks after application |                     |                     |                     |                     |                      |
|--------------------|--|---------------------|---------------------|---------------------|---------------------|----------------------|
|                    | Pre count                              | 2 <sup>nd</sup> wk. | 4 <sup>th</sup> wk. | 6 <sup>th</sup> wk. | 8 <sup>th</sup> wk. | 12 <sup>th</sup> wk. |
| Untreated Control  | (35.1)36.35a                           | (30.8)33.72b        | (38.5)38.34c        | (39.8)39.13d        | (35.3)36.45e        | (40.3)39.41b         |
| Argel soil 100g    | (35.9)36.80a                           | (67.4)55.20a        | (72.8)58.55b        | (77.1)61.39a        | (72.8)58.58abc      | (51.1)45.65ab        |
| Argel spray 100g   | (37.4)37.72a                           | (67.5)55.25a        | (74.4)59.61b        | (76.9)61.30a        | (73.7)59.17ab       | (51.8)46.03ab        |
| Argel soil + spray | (37.5)37.78a                           | (71.5)57.76a        | (82.2)65.04a        | (78.0)62.04a        | (78.2)62.14a        | (50.9)45.53ab        |
| Usher soil 100g    | (35.7)36.71a                           | (71.6)57.79a        | (72.4)58.33b        | (73.7)59.14ab       | (71.2)57.51bc       | (49.3)44.58ab        |
| Usher spray 100g   | (32.0)34.46a                           | (68.7)55.89a        | (71.6)57.81b        | (65.0)53.72c        | (66.6)54.71cd       | (47.8)43.77ab        |
| Usher soil + spray | (34.0)35.68a                           | (69.7)56.57a        | (73.3)58.86b        | (67.2)55.09bc       | (62.8)52.40d        | (45.4)42.34b         |
| Actara 25WG 20g    | (33.8)35.58a                           | (73.6)59.07a        | (77.3)61.56ab       | (74.2)59.50ab       | (72.8)58.53ab       | (61.6)51.69a         |
| CV%                | 9.27                                   | 5.35                | 6.21                | 6                   | 5.09                | 13.59                |
| LSD                | 2.312                                  | 3.738               | 4.604               | 4.385               | 3.62                | 7.9                  |
| SE±                | 7.980                                  | 1.290               | 1.589               | 1.514               | 1.249               | 2.727                |

\*Original means are shown within brackets.

\*Means were transformed (arcsine transformations).

\*Arcsine transformed means were separated by Duncans multiple range test at alpha = 0 .05

**Second treatment (May 2007):****Gharb Dongola site:**

The results of the 2<sup>nd</sup> treatments at this site are shown in table 3. Table 3 indicates that all treatments caused significant increase in mortality in the immature stages compared to the

untreated control up to the 8<sup>th</sup> week after application. The standard insecticide Actara remained effective up to the 12<sup>th</sup> week, while other treatments were not significantly different from that of the control

Table 3: Mean mortality rate (%) of immature stages of the green pit scale insect at Gharb Dongola (May 2007)

| Treatments         | Mortality % in weeks after application |                     |                     |                     |                     |                      |
|--------------------|--|---------------------|---------------------|---------------------|---------------------|----------------------|
|                    | Pre count                              | 2 <sup>nd</sup> wk. | 4 <sup>th</sup> wk. | 6 <sup>th</sup> wk. | 8 <sup>th</sup> wk. | 12 <sup>th</sup> wk. |
| Untreated Control  | (34.8)36.14b                           | (37.1)37.53c        | (36.8)37.35b        | (39.4)38.90e        | (41.4)39.88c        | (46.2)41.81b         |
| Argel soil 100g    | (37.1)37.50ab                          | (70.5)57.12b        | (75.5)60.35a        | (74.9)59.91bc       | (79.3)62.92a        | (43.3)41.15b         |
| Argel spray 100g   | (36.7)37.31ab                          | (70.5)57.09b        | (79.1)62.81a        | (78.2)62.14b        | (79.3)64.25a        | (44.3)41.75b         |
| Argel soil + spray | (37.1)37.53ab                          | (72.0)58.04ab       | (77.7)61.81a        | (78.9)62.65b        | (78.4)62.34a        | (48.9)44.36b         |
| Usher soil 100g    | (36.3)37.07ab                          | (75.5)60.30ab       | (77.4)61.63a        | (79.4)63.04b        | (76.5)60.99a        | (50.4)45.22b         |
| Usher spray 100g   | (37.1)37.50ab                          | (76.6)61.06a        | (79.3)62.97a        | (71.2)57.56cd       | (76.8)61.23a        | (45.1)42.21b         |
| Usher soil + spray | (34.1)35.72b                           | (71.8)57.94ab       | (75.8)60.50a        | (69.3)56.36         | (69.8)56.64b        | (49.8)44.88b         |
| Actara 25WG 20g    | (41)39.82a                             | (74.7)59.81ab       | (80.3)63.63a        | (83.9)66.36a        | (80.6)63.85a        | (60.0)50.77a         |
| C.V.%              | 6.44                                   | 4.27                | 4.21                | 4.03                | 4.93                | 6.91                 |
| LSD                | 3.114                                  | 3.107               | 3.215               | 3.047               | 3.771               | 3.943                |
| SE±                | 1.075                                  | 1.073               | 1.11                | 1.052               | 1.302               | 1.361                |

\*Original means are shown within brackets.

\*Means were transformed (arcsine transformations).

\*Arcsine transformed means were separated by Duncans multiple range test at alpha = 0 .05

**Elikinduwa site:**

The results of treatments at this site are shown in table 4. It was clear from these results that, the standard insecticide Actara was effective during the whole

period of the experiment up to 12<sup>th</sup> week. The other treatments of argel and usher also showed efficiency but at variable degree up to the end of the treatment period.

Table 4: Mean mortality rate (%) of immature stages of the green pit scale insects at Elikinduwa (May 2007).

| Treatments         | Mortality % in weeks after application |                     |                     |                     |                     |                      |
|--------------------|--|---------------------|---------------------|---------------------|---------------------|----------------------|
|                    | Pre count                              | 2 <sup>nd</sup> wk. | 4 <sup>th</sup> wk. | 6 <sup>th</sup> wk. | 8 <sup>th</sup> wk. | 12 <sup>th</sup> wk. |
| Untreated Control  | (35.1)36.30b                           | (37.0)37.45d        | (33.4)35.26d        | (36.4)37.08c        | (36.7)37.26c        | (42.7)40.78c         |
| Argel soil 100g    | (35.0)36.27b                           | (74.9)59.90bc       | (75.1)60.06c        | (77.6)61.74ab       | (77.0)61.37b        | (54.7)47.69ab        |
| Argel spray 100g   | (34.8)36.13b                           | (79.3)62.96ab       | (82)64.89ab         | (77.1)61.40ab       | (80.4)63.71ab       | (49.3)44.59abc       |
| Argel soil + spray | (36.0)36.86b                           | (77.3)61.56b        | (81.3)64.36ab       | (81.5)64.51a        | (80.3)63.68ab       | (57.2)49.15a         |
| Usher soil 100g    | (35.4)36.49b                           | (71.4)57.69c        | (76.3)60.90c        | (75.9)60.62ab       | (76.7)61.14a        | (50.9)45.50ab        |
| Usher spray 100g   | (33.5)35.39b                           | (72.2)58.15c        | (74.6)59.74c        | (72.8)58.56b        | (76.1)60.74b        | (48.8)44.30bc        |
| Usher soil + spray | (34.3)35.85b                           | (74.5)59.69bc       | (77.8)61.96bc       | (81.4)64.44a        | (79.9)63.39ab       | (52.1)46.18ab        |
| Actara 25WG 20g    | (42.7)40.77a                           | (82.2)65.06a        | (84.1)66.53a        | (81.3)64.40a        | (83.7)66.16a        | (57.1)49.10a         |
| CV%                | 6.83                                   | 4.02                | 4                   | 4.67                | 5.97                | 7.01                 |
| LSD                | 3.252                                  | 3.010               | 3.69                | 3.5732              | 4.652               | 4.167                |
| SE±                | 1.122                                  | 1.039               | 1.059               | 1.233               | 1.606               | 1.438                |

\*Original means are shown within brackets.

\*Means were transformed (arcsine transformations).

\*Arcsine transformed means were separated by Duncans multiple range test at alpha = 0 .05.

## DISSCUSION

In the present experiments, argel and usher were tested against the immature stages of the green pit scale insect in comparison to a standard insecticide Actara, and untreated control twice a year (e.g. in January and May).

The results of the treatments made at the two sites showed that extracts of the two plants were effective against the immature stages of the insect, and the percentages of mortality obtained were significantly higher than those of the untreated control. Their effectiveness extended for 8 – 10 weeks after application and declined by the 12<sup>th</sup> week. Although there were slight differences between treatments of the two extracts, yet they were mostly of the same potency. In addition, the efficiency of some of these treatments was comparable to that of the standard insecticide Actara.

The present results are in agreement with those of Sidahmed *et al.* (2009) who reported that, Argel shoot aqueous filtrates significantly increased the mortality of adult females of white scale insect (*Parlatoria blanchardii*) in the Northern State. AL-Doghairi, *et al.* (2004) mentioned that bioactive effects of methanolic extracts of shoot parts of argel were mostly attributed to the presence of a variety of bioactive organic substances mainly terpenes, pergnine, glycosides, alkaloids and sterols. Also, previous studies by Erdman (1983), Al-. Robai *et al.* (1993), Hussein *et al.* (1994) and Mohammed (1999) reported the presence of alkaloids, flavonoids, cardiac glycosides as well as sterols and usharin in the entire parts of usher plant (*Calotropis procera*).

Concerning the effect of those compounds, the studies of Blades and Mitchell (1986) and Ongilagha *et al.* (2004), showed that the alkaloids and flavonoids of many plants have a repellent and antifeeding effects against many insect pests. In this context, the results of Ahmed *et al.* (2006) showed

that, (*C. procera*) aqueous extract has a repellent and antifeeding effects against the melon lady bird (*Henosepilachana elateri*). Moreover, Hag El Tayeb *et al.* (2009) confirmed that, the toxic effect of water extracts of argel showed the best LD<sub>50</sub> against *Cx. quinquefasciatus* (0.006ml/L) and *An. arabiensis* (0.140ml/L), as compared with Usher extract (0.108 and 0.263 ml/L, respectively).

Both argel and usher belong to the same plant family Asclepidiaceae and they grow wild in northern Sudan. Argel is subject to collection and sold in local markets for about 2.0 SDG / pound (ca. 0.8 US\$). According to the results of the present study, its cost /palm tree will be about 0.5 SDG only. Usher grows wild also and is not collected or sold. Its use would be at no cost. However, the cost of the recommended dose of Actara is about 12.5 SDG (ca. 5 US\$) per palm.

Considering bio-safety, environmental hazards and cost, this study suggests that both argel and usher extracts could be a substitute of Actara for the control of the immature stages of the green pit scale insect on date palms.

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