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ARGEL (*Solennostemma argel* Del. Hayenne) APPLICATIONS FOR CONTROL OF THE DATE PALM GREEN PIT SCALE INSECT (*Asterolicanium phoenicis* Rao) AND YIELD ENHANCEMENT

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ABSTRACT

The epidemiology of the exotic green pit scale insect on Sudan's main growing Date Palm State had been of negative impact on dates yield. As cost of the recommended pesticide was high, adoption of the recommendation was partial. In this study foliar, soil and combined foliar and soil applications of argel were compared for their potency to control this insect against the recommended pesticide and untreated control. A 100 g argel dose/ palm applied as foliar or soil dressing gave satisfactory control matching that of the chemical pesticide for around 3 months. Besides, clear yield gains were obtained upon argel application coupled with optimum cultural practices. Being a safe cheap local herb, argel can be proposed as an alternative or supplement to the chemical pesticide for the control of the green pit scale insect and enhanced date palm yield.

Keywords: argel, S*olennostemma argel* Del. hayenne, green pit scale insect, *Asterolicanium phoenicis* rao, date palm, yield.

INTRODUCTION

Sudan dates are mainly of the dry type which are easy to store and transport without remarkable losses. Dry dates are food sources rich in energy with high sugar and low water contents. Date palm cultivation is a major economical activity in the Northern State of Sudan where dates constitute about 75% of the State exports and are symbols of wealth and social status (Dirar, 2003). Date palms in Northern State had been subject to attacks by numerous insect pests and diseases that caused considerable yield losses (Idris *et al*., 2006). The most serious is the date palm green pit scale insect *Asterolicanium phoenicis* (Rao), which was introduced in 1976 through illegal importation of one infested off-shoot from Saudi Arabia. As natural biological control agents of this pest are lacking in the state, it has become a serious pest in an area of around 5000 ha, infesting around one million palms. The green pit scale insect has spread to other states despite the strict plant quarantine measures and was therefore considered a national pest receiving federal attention. Although chemical insecticides had been important tools in the control of this pest (Ahmed, 2003, 2005 and 2007), suggestions for alternative means of control had been proposed (Goulding, 1988; Ibrahim *et al*., 2003). The use of synthetic insecticides is costly and hazardous as chemical residues in food, water, and environment might cause serious health troubles (Buss and Brown, 2006). Botanical insecticides have long been proposed as safe alternatives to chemical insecticides because they pose little threat to the environment and human health (Isman, 2006). Botanicals degrade rapidly by detoxification enzymes in sun-light, air and moisture. Rapid break down means less persistence and reduced risks to non targeted organisms, but precise timing and more frequent application may be necessary (Buss and Brown, 2006). Argel (*Solennostemma argel* Del. Hayenne) is a herb of wide use in Sudanese traditional medicine that grows wild in the Northern and Nile States (Elkamali and Khalid, 1996). Phyto-chemicals of medicinal properties from argel shoots had been reported by many workers (Kamel *et al*., 2000; Hamed, 2001). Antimicrobial properties of argel were reported by Roos *et al*. (1980), Elhady *et al*. (1994) and Sulieman *et al*. (2009). According to Idris *et al*., (2011), soil application of argel's dry leaves under the conditions of the Northern State enhanced flowering and yield of a dry date cultivar and the influence was attributed to either pesticide or growth promoting ingredients.

This study aimed to explore the potential of argel application as safe means of control of the green pit scale insect and its extended effect as yield enhancer of date palm.

MATERIALS AND METHODS

The study was carried out at Elghaba Agricultural Scheme in the Northern State, which has a long history in date palm cultivation in Sudan. The area had been highly infested by the green pit scale insect *(A. phoenicis*) with remarkable loss in dates yield compared to other regions in the State. The experiment was conducted in Arab Narti and Waddiab villages which were 5 kilometers apart. Single 10-12 years old date palms of Barakawi cultivar, whose offshoots were removed, were used in a randomized block design. The orchard in Waddiab was well managed compared to that in Arab-Narti. Single and combined foliar and soil argel applications in doses of 100 g/palm were compared against untreated control as well as against soil application of the recommended chemical

pesticide Actata 25WG (20g/palm). Four palms were employed per treatment where each palm was considered a replicate.

Dry argel leaves collected from local market were ground and kept in plastic bags under room conditions. Water was added to argel powder in concentration of 10 g/l, stirred manually for 5-10 minutes and was left for 24 hours for full dissolving. The mixture was then filtered through cotton cloth for spray. Each palm received 10 liters as a foliar treatment to leaf run-off and extracts were freshly prepared upon need. For soil application, argel powder was mixed with soil in a circular ditch 50 cm away from the base of the trunk and irrigated immediately. Actara 25 WG was added to water in plastic containers, thoroughly stirred and the mixture was poured into a circular ditch 50 cm away from the base of the trunk. Preliminary counts of infestation were taken prior to treatments and afterwards regular samples were taken for count every two weeks up to the 14th week from the beginning of the experiment. However, sampling was not done in the 10th and 12th weeks. 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 1cm² at the base, the middle and the tip of the leaflet was examined under a binocular microscope and the readings were recorded for percentage mortality of the adult females and immature stages. Any female was considered dead when the color of its scale had been changed from green to black or brown. If there was any doubt about the death of any female, 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 insect, it can be found moving around itself for certain seconds before its mouth parts were released from the leaflet. At harvest, the yield of palms was recorded. Yield estimation was based on the actual weight of 2 randomly chosen bunches/palm. The mean weight of the 2 bunches was multiplied by the actual number of bunches/palm. Mortality data were arcsine transformed according to Gomez and Gomez (1984). of variance and means were separated by Duncan's multiple range tests at 95% confidence limits.

RESULTS

Figure-1 shows the effect of treatments on adult green pit scale insects at Arab Narti. Actara and the different forms of argel increased mortality of the adult females significantly over the control up to the 14th week. In the 4th week, all argel treatments and Actara performed similarly. This trend extended up to the 8th week. In the 14th week argel soil application was less effective compared to the other argel and Actara treatments.

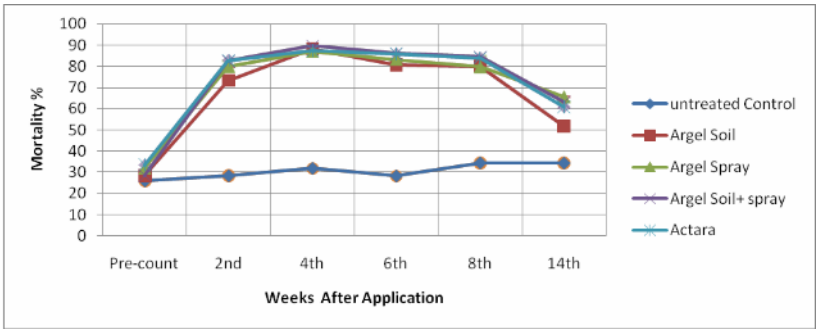

Figure-1. Mean mortality of adult females of the green pit scale insect treated by argel and Actara in Arab-Narti.

As illustrated in Table-1, all treatments increased the mortality of the immature stages compared to control up to the 14th week. Up to the 6th week, treatments performed almost similarly with significant increase in mortality compared to the control. In the 8th week, Actara ranked top and all argel treatments ranked second. In the 14th week, argel and Actara treatments shared equally high mortality of the immature stages compared to control without significant differences between them.

Table-1. Mean mortality percentage of immature stages of the green pit scale insect treated by argel and Actara at Arab-Narti.

Treatments	Mortality % in weeks after application					
	Pre count	2nd wk.	4th wk.	6th wk.	8th wk.	14th wk.
Untreated	(28.9)32.49a	(25.0)30.03b	(23.0)28.68b	(24.3)29.56b	(28.5)32.28c	(33.9)35.62b
Argel soil	(24.8)29.85a	(53.8)47.20a	(81.5)64.56a	(67.9)55.48a	(70.2)56.88b	(55.5)48.17a
Argel spray	(23.0)28.68a	(59.5)50.45a	(84.8)67.08a	(72.9)58.54a	(71.3)57.60b	(63.2)52.62a
Argel soil + spray	(24.3)29.54a	(63.9)53.06a	(76.6)61.08a	(74.3)59.55a	(67.2)55.04b	(61.4)51.56a
Actara25WG	(28.2)32.06a	(63.1)52.59a	(83.2)65.81a	(69.2)56.28a	(77.6)61.72a	(65.9)54.26a
CV%	16.44	8.18	8.59	6.31		7.93

*Original means are shown within brackets.
*Arcsine transformed means separated by Duncans multiple range tests at alpha = 0 .05

The result of the different treatments on adults at Waddiab is shown in Table-2. As in Arab Narti, all argel and Actara treatments excelled the control and caused high mortality rates of adult females. In the 2nd week all treatments were superior over the control without significant differences between them. In the 4th week Actara ranked second while argel spray and argel combined treatment ranked top. From the 6th week on, all treatments performed similarly as in the second week.

Table-2. Mean mortality percentage of adult females of green pit scale insect treated by argel and Actara at Waddiab.

Treatments	Mortality % in weeks after application					
	Pre count	2nd wk.	4th wk.	6th wk.	8th wk.	14th wk.
Untreated	(40.0)39.22a	(36.9)37.41b	(39.7)39.07c	(34.8)36.17b	(30.9)33.75b	(38.7)38.52b
Argel soil	(37.7)37.89a	(83.1)65.73a	(88.4)70.08ab	(87.7)69.46a	(79.6)63.13a	(65.9)54.25a
Argel spray	(30.9)33.75a	(87.3)69.08a	(91.9)73.48a	(88.9)70.50a	(85.7)67.74a	(68.9)56.12a
Argel soil + spray	(34.8)36.15a	(83.5)66.03a	(91.0)72.53a	(88.3)69.96a	(84.3)66.63a	(67.6)55.32a
Actara 25WG	(38.5)38.35a	(89.1)70.72a	(84.8)67.03b	(86.4)68.34a	(80.7)63.91a	(69.6)56.56a
CV%	12.63	7.60	4.48	5.16	5.62	4.77

*Original means are shown within brackets.
*Arcsine transformed means separated by Duncans multiple range tests at alpha = 0 .05

The mortality of the immature stages of the green pit scale insect at Waddiab is shown in Table-3. Up to the 8th week, the different treatments caused high mortalities than the control. In the 2nd week, Actara was best while the combined argel treatment (spray + soil) ranked second. However, the single treatments of argel ranked intermediate. From the 4th up to the 8th week, no significant differences were detected between the argel and Actara treatments that caused significant high mortalities compared to the control.

Table-3. Mean mortality percentage of immature stages of the green pit scale insect treated by argel and Actara at Waddiab.

Treatments	Mortality % in weeks after application					
	Pre count	2nd wk.	4th wk.	6th wk.	8th wk.	14th wk.
Untreated control	(20.1)26.66b	(27.4)31.59c	(25.8)30.51b	25.8)30.52b	(27.6)31.70b	(47.4)43.49a
Argel soil	(30.1)33.27a	(76.4)60.91ab	(76.9)61.27a	(74.8)59.84a	(77.2)61.67a	(54.6)47.63a
Argel spray	(26.5)31.0a	(71.6)57.78ab	(79.8)63.29a	(77.3)61.52a	(80.6)63.89a	(52.8)46.58a
Argel soil+spray	(25.8)30.53a	(71.6)57.80b	(77.2)61.51a	(75.4)60.25a	(77.0)61.31a	(49.2)44.51a
Actara25WG	(27.0)31.31a	(79.7)63.22a	(82.8)65.48a	(79.7)63.25a	(83.5)66.03a	(55.4)48.13a
CV%	7.24	4.28	9.81	9.43	7.92	7.1

*Original means are shown within brackets.
*Arcsine transformed means were separated by Duncans multiple range test at alpha = 0 .05

Figure-2, demonstrates the effect of treatments on yield at Arab-Narti. Argel soil application and argel foliar treatments resulted in significant yield increase compared to Actara and the control while the combined treatment ranked intermediate.

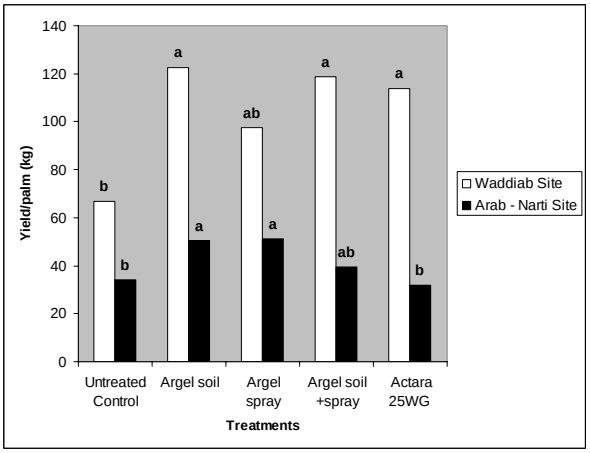

Figure-2. Yield of date palms as affected by argel and Actara applications.

At Waddiab, argel soil application, the combined argel treatment and Actara resulted in significant higher yield compared to the control while argel foliar spray ranked intermediate. Generally, the yield Figures at Wddiab were higher compared to Arab Narti.

DISCUSSIONS

Plants may provide potential alternatives to the currently used insect control agents because they constitute a rich source of bioactive chemicals (Wink, 1993). According to Badshah *et al*., (2004) there are over 1000 plant species that have chemicals in leaves, stems, flowers and roots with insecticidal properties, but few of them were exploited commercially. The chemical poisons of plants are mostly alkaloids which are nitrogenous in nature with heterocyclic compounds having strong disturbing effects on the nervous system of animals. Use of synthetic insecticides leads to destabilization of the eco-system and to enhance resistance to insecticides in pests (Dittrich *et al*., 1990). Numerous studies had been carried out in Sudan to assess the efficacy of local herbs as control means against insect pests in field and laboratory trials. Encouraging findings had been reported (Siddig, 1991; ELkamali, 2001; Ali, 2004; Mohmed, 2004; Eltayb, 2005; Bakhiet and Taha, 2009 and Sidahmed *et al*., 2009).

The tremendous damage of green pit scale insect imposed on dates' yield has become a national issue. Hence, control efforts recommended the application of synthetic pesticides (Ahmed *et al.*, 2002) among which Actara 25WG was considered of relative safety and efficiency (Ahmed, 2005). However, the cost of chemical treatment was a limiting bottle-neck, as the recommended dose costs around SDG 12.5 per palm. The results of this study showed the efficacy of argel applications as control means against the green pit scale insect on date palms. The applications caused mortality of adult females and immature stages of the insect similar or closer to the effect of Actara. The single foliar or soil application was as efficient as or better than the combined treatment. This suggests adequacy of application of a single dose of 100 g/palm. It is noteworthy that soil application of argel loses control potency earlier than other treatments which is a sign of degradation. Nevertheless, this study proposed argel as an efficient cheap botanical alternative for chemical insecticides for the control of the green pit scale insect, as the 100 g argel dose costs only SDG 0.5. Therefore, this alternative seems economically feasible. Considering bio-safety and bio-balance the use of botanicals is safer than synthetic insecticides. The insecticidal properties of argel on the green pit scale insect match the findings of Sidahmed *et al*., (2009) who reported efficient control of the white scale insect *Parlatoria banchardii* on date palm by argel application in the Northern State. Argel increased yield in most cases compared to Actara which is an additional advantage.

Yield differences in the two experimental sites may owe to differences in cultural practices such as pruning, irrigation and fertilizers application. Nevertheless, this finding is in line with results of Idris *et al*., (2011) who reported exceptional yield increments in date palms treated by argel and owed this increment to either pesticide or growth-regulator-like ingredients in argel's plant leaves. More-over, Aldoghairi *et al*., (2004), mentioned that the bioactivity of the methanolic extracts of shoot parts of argel were mainly attributed to the presence of a variety of bioactive organic substances mainly pergnine, glycosides, alkaloids and sterols.

CONCLUSIONS

To counteract the adverse effects of the green pit scale insect on date palm, argel foliar and soil applications in a dose of 100 g/palm almost matched the influence of the recommended insecticide (Actara 25 WG) on the insect and enhanced yield considerably. However, the application should be coupled with optimum cultural practices for high yield gains. Considering availability, cost and bio-hazards, adoption of argel application seems valid for a large scale control program. The incorporation of botanicals for pest control could be a safe alternative or supplement to the high cost of synthetic pesticides, especially in developing countries like Sudan.

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