ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of
DEVELOPMENT RESEARCH

International Journal of Development Research
Vol. 4, Issue, 11, pp. 2225-2229, November, 2014

Full Length Research Article

INTEGRATIVE APPROACHES FOR THE MANAGEMENT OF JUJUBE BEETLE, *ADORETUS PALLENS*

[1*]Imtiaz A. Nizamani, [2]Maqsood A. Rustamani, [3]Shafi M. Nizamani and [1]M. Ibrahim Khaskheli

[1]Department of Plant Protection, Sindh Agriculture University, Tando Jam, Pakistan
[2]Department of Entomology, Sindh Agriculture University, Tando Jam, Pakistan
[3]National Centre of Excellence in Analytical Chemistry, University of Sindh, Jamshoro, Pakistan

ARTICLE INFO

Article History:
Received 13th August, 2014
Received in revised form
15th September, 2014
Accepted 28th October, 2014
Published online 18th November, 2014

Key words:
Jujube,
Ziziphus mauritiana;
Light trap,
Botanicals,
Insecticides

ABSTRACT

Jujube, *Ziziphus mauritiana* is one of the most ancient fruit crops of Sindh, Pakistan consumed for its nutritional and medicinal purpose. However, the occurrence of foliage insect pests especially jujube beetle (*Adoretus pallens* Har) is the major threat to reduce the quality and quantity of fruits, ultimately causing tremendous economic loss to the growers. Thus, the main focus of current study was to develop the Integrative Pest Management (IPM) approaches for jujube beetle. Light trap, botanicals (Neem Seed Extract, NSE; Neem Leave Extract, NLE; Dhatur and their combinations: Dhatur+NSE, Dhatura+NLE) and insecticides (Larsben, Laser, Radiant, Polytrine-C and Tal Star-) were evaluated for the control of *A. pallens*. Maximum mean population of two years was light trapped on 30th June and 30th May followed by 30th September, 15th June and 30th August, however, no significant difference was observed for trapping of *A. pallens* in these months. Significant reduction in the infestation of *A. pallens* was obtained with Neem Seed Extract (NSE) followed by NSE+Dhatura and Neem Leave Extract (NLE)+Dhatur indicates their higher efficacy. Lorsben followed by Radiant was remained more effective, which reduced *A. pallens* population below the ETL, whereas, the efficacy of Talstar and Polytrine-C was observed poor. It is obvious from the current study that *A. pallens* can be managed efficiently by using light trap and NLE, however, in case of severe infestation Lorsben and Radiant are suggested.

INTRODUCTION

Jujube, *Ziziphus mauritiana* L. is one of the most ancient and important fruit crops. It is considered as the King of arid zone fruits, due to its adaptations to tolerate the biotic and abiotic stresses prevailing under rain fed conditions (Anbu *et al.,* 2009). Jujube fruit is one of the world's most nutritious plants, provide energy for human consumption and play a vital role in the development of human body (Kaseem *et al.,* 2011; Padmanabhan *et al.,* 1993). There is a traditional Chinese proverb that "eating three jujubes a day keeps the doctor away" (Bao, 2008). Generally they are eaten as fresh, however, may be pickled, dried and made into confectionery, or juice can be extracted for drinks (DeKock, 2006). Jujube is known to attack by 23 different species of insect pests, however, out of these 13 species attack on the foliage right from sprouting to fruit harvest (Khan 1994).

Corresponding author: Imtiaz A. Nizamani
Department of Plant Protection, Sindh Agriculture University, Tando Jam, Pakistan

It is also reported that Leaf roller (*Ancylis sativa; Synclera univocalis* Wlk), Hairy caterpillar (*Euproctis fraterna* Moore) and Jujube beetle (*Adoretus pallens* Har) are the serious foliage insect pests (Sudheer *et al.,* 1990; Shah *et al.,* 1990; Wen, 1998; Man and Kansal, 1999). These foliage insect pests are not only cause damage on leaves but their attacks ultimately loosen the vigor of the tree and thus the fruit production is also reduced. However, among above listed insect pests, Jujube beetle is a serious foliage insect pest and is active during summer (May-August). The damage is caused by adults during night by eating round holes. In case of severe attack, such trees do not bear any fruit (Khan, 1994). Jujube beetle which is also called as Chafer beetle or ber beetle or leaf chafer. Various species of jujube beetles (*Adoretus decanus, A. kanarensis, A. stoliezkae, A. pallens, A. versutus*) (Coleoptera: Scarabaeidae) mainly devour the foliage during the night time. In the rainy season when new growth starts, it becomes more active and cause severe infestation. Leaves are generally become like sieves and, in severe cases; the whole tree is rendered leafless (Williams, 2006). The jujube crop is grown alone and in combination with other fruits, vegetables

and fodder crops. Intercropping with jujube provides ample chances of multiplication of jujube pests, as many of alternate host plants serve as food plants of jujube insect pests. Several management practices are used to control jujube insect pests, however, in some cases it is difficult to control the insect pests specially the nocturnal pests such as jujube beetle. In such cases light traps are playing an increasingly important role as a pest management strategy in greenhouse crops as well as in orchards. It provide an easy to use non-pesticide alternative tool for reducing and suppressing moth and beetle pests. Light traps are operated at night and are most effective from sunset till after midnight with clouded skies. This technique is generally applied for the collection of moths, scarabaeid beetles, some Hemiptera and Hymenoptera insects. The beetles have been reported to be trapped by using any source of light and killed by dropping them into water containing kerosene (Williams, 2006) or some other available chemicals. The tremendous developments in the range of chemicals to be used as pesticides have made a definite impact on pest control. The rapidity and effectiveness with which the pest can be eliminated by the use of such chemicals have made them essential component of agricultural practices. However, chemical pesticides are totally harmful to human being as well as all other livings, general environment, agro-ecosystem and ultimately damage the whole biodiversity. Thus, the present study was conducted to find out integrative approaches for the management of jujube beetle.

MATERIALS AND METHODS

To develop the integrated pest management (IPM) model of jujube beetle various field and laboratory experiments were conducted at the orchards of Tando Qaiser, Hyderabad District and Department of Plant Protection, Sindh Agriculture University, Tando Jam, Pakistan, respectively. Different IPM approaches viz, light trap, botanicals and insecticides were tested to reduce the infestation of jujube beetle. The details of each experiment conducted are presented hereunder:

Use of Light trap

Four light traps acre-^{1} at different places were installed in the jujube orchards and operated at night to attract the jujube beetle. A light source was fluorescent bulb which was assembled in light trap and the trapped insects were killed with the potassium cyanide placed in the mounted glass jar (Plate 1). Data was recorded on daily basis; weekly mean and overall population was calculated in the current experiment. The experiment was repeated during both year of study to confirm the reduction in the infestation percentage.

Evaluation of various botanical extracts

The efficacy trials of four different formulations of Neem (*Azadirachta indica* L.) and Dhatura (*Datura stramonium* L.) for the control Jujube beetle was evaluated (Table 1). All experiments were conducted on naturally occurring pest populations. For each treatment, a row of susceptible variety, Golden Gola with 10 jujube trees was selected and treated thrice (15th May, 15th June and 15th July) in a year. A control row was also maintained for the comparison of pest population. The observation of treatments was assessed by counting the number of live larvae/adults. Pre-treatment observations were recorded one day before and post-treatment observations after spray on weekly basis. The detail of each formulation is mentioned below:

Table 1. Botanical extracts used to control the jujube beetle

Formulation	Botanical name	Plant Part used	Dose L^{-1}
Neem Leaf Extract (NLE)	*Azadirachta indica* L.	Leaves	50g
Neem Seed Extract (NSE)	*Azadirachta indica* L.	Seed with coat	50g
Dathura	*Datura stramonium* L	Seed	50g
NLE+Dhatura	-	-	50g
NSE+Dhatura	-	-	50g

Neem Leaves Extract (NLE)

Fresh leaves of the neem (1kg Leaves/5 L water) tree were soaked for 24 hours in water. On the next days, the solution was filtered through fine gauze (muslin cloth) to remove the bigger particles; the filtered solution was then ready for field application (spraying). Before the spray, 1.0g of washing powder was added. The spraying was done in the morning using knapsack and power sprayer.

Neem Seed Extract (NSE)

The spray solution was prepared as water extract of the kernel of neem fruits at the concentration of 50g L^{-1} water. The dry fruits (along with skin coat) of neem were crushed lightly to break them, the seed kernel were then powdered using an electronic blender. The mixture was kept for 24 hours and on the next day, the solution was filtered through fine gauze to remove the bigger particles; the filtered solution was then ready for field application. In the spray solution, 1.0g of washing powder was added. The spraying was done in the morning using knapsack and power sprayer.

Dhatura Extract (DE)

The spray solution was prepared as water extract of dhatura fruits at concentration of 50g L^{-1} water same as NSE. The spraying was done in the morning using knapsack and power sprayer.

Combinations

Two different combinations viz; NLE+Dhatura and NSE+Dhatura were used to test the efficacy against jujube beetle. Both extract were prepared same as explained for NLE and NSE, respectively. In the spray solution, 1.0g of washing powder was added. The spraying was done in the morning using knapsack and power sprayer.

Evaluation of various commercial insecticides

The efficacy trials of five different insecticides for the control of Jujube beetle were evaluated at the farmer's fields (Table 3.3). All experiments were conducted on naturally occurring insect pest populations following the same method as explained above for botanicals. All the insecticides were applied using a knapsack and power sprayers. The experiment was repeated two times during 2007 and 2008.

Table 2. Insecticides used to control the jujube beetle

Common Name	Trade name	Chemical Group	Manufacturer	Dose ($200L^{-1}$ water)
Chloropyriphos	Larsben- 40 EC	Organo Phosphate (OP)	Dow Agro Science	300ml
Dimethoate + Cypermethrin	Laser- 25EC	OP+Pyrethroid	Pak Agro	500ml
Spinetoram	Radiant-120 SC	Spinosyn	Dow Agro Science	20 ml
Cypermethrin+ Perofenofos	Polytrine-C 440EC	OP+Pyrethroid	Syngenta	250ml
Bifenthrin	Tal Star-10 EC	Pyrethroid	FMC	200ml

Assessment of treatment efficacy

The efficacy percentage of botanicals and insecticides was calculated for monthly mean population by using by using Henderson-Tilton's formula (Henderson and Tilton, 1955) as below:

$$\text{Corrected \%} = \left(1 - \frac{\text{n in Co before treatment} * \text{n in T after treatment}}{\text{n in Co after treatment} * \text{n in T before treatment}}\right) * 100$$

Where : n = Pest population , T = Treated , Co = Control

Statistical Analysis

The data collected on the population of jujube beetle were subjected to analysis of variance (ANOVA); to test the superiority of mean values LSD test was applied and all differences described in the text were considered significant at the 5 % level of probability. These analyses were performed using computer software package Statistix 8.1 (Analytical Software 2005).

RESULTS AND DISCUSSION

Effect of light trap

The population of *A. pallens* captured with light trap during 2007 and 2008 is presented in Figure 1. It is obvious from the statistical analysis that there was no significant different between two years; however, significant difference was found in the weekly mean population of light captured (Table 3).

Table 3. Analysis of variance for light trapped mean population of *A. pallens* moth recorded during 2007 and 2008

Source	DF	SS	MS	F	P
Traps	3	23.17	7.724	0.70	0.5558
Weeks	23	4520.65	196.550	17.70	0.0000
Year	1	16.05	16.048	1.45	0.2308
Trap*Weeks	69	210.76	3.054	0.28	1.0000
Trap*Weeks*Year	95	19.51	0.205	0.02	1.0000
Error	192	2131.96	11.104		
Total	383	6922.10			
CV = 70.18					

Maximum mean population of two years was trapped on 30th June (12.88 $acre^{-1}$) and 30th May (12.15 $acre^{-1}$) with no significant difference followed by 30th September (9.46 $acre^{-1}$), 15th June (8.73 $acre^{-1}$) and 30th August (7.26 $acre^{-1}$), however, no significant difference was observed for trapping of *A. pallens* in these months. The population of *A. pallens* was observed lower in the month of December, January and February of both years, 2007 and 2008 (Figure 1).

Effect of different botanical

The results achieved on percentage reduction in *A. pallens* in various botanical extract alone and combinations including Neem Leaf Extract (NLE), Neem Seed Extract (NSE), Dhatura, NLE+Dhatura and NSE+Dhatura are presented in Figure 2. It is evident from the data that efficacy percentage significantly varied between the treatments, however, no significant difference was observed for two experiments conducted during 2007 and 2008 (Table 4). The infestation percentage of *A. pallens* was significantly reduced with NSE followed by NSE+Dhatura and NLE+Dhatura indicates their higher efficacy (42.51, 40.14 and 38.30%), respectively, against *A. pallens* under field conditions after three application, however, no significant difference was observed in these three treatments. The efficacy of Dhatura (31.41%) and NLE (34.77%) was lower with no significant difference compared to others (Figure 2).

Table 4. Analysis of variance for efficacy of different botanical extracts against *A. pallens* in field conditions of jujube

Source	DF	SS	MS	F	P
Treatment	5	24890.0	4978.00	96.63	0.0000
Year	1	32.6	32.55	0.63	0.4286
Tree	9	2046.2	227.36	4.41	0.0001
Treatment*Year	5	6.5	1.30	0.03	0.9997
Error	99	5100.3	51.52		
Total	119	32075.5			
CV = 23.01					

Effect of different commercial insecticides

The results on the effect of various commercial insecticides used against the *A. pallens* are presented in Figure 3. The statistical analysis revealed that there was no significant different between two years; however, significant difference was found in the efficacy of different pesticides and spray applications (Table 5).

Table 5. Analysis of variance for efficacy of different commercial insecticides against *A. pallens* in field conditions of jujube

Source	DF	SS	MS	F	P
Pesticide	5	286.014	57.2029	1414.34	0.0000
Spray	2	15.914	7.9568	196.73	0.0000
Year	1	0.154	0.1542	3.81	0.0518
Tree	9	2.660	0.2956	7.31	0.0000
Pesticide*Spray	10	22.766	2.2766	56.29	0.0000
Pesticide*Spray *Year	17	0.019	0.0011	0.03	1.0000
Error	315	12.740	0.0404		
Total	359	340.267			
CV = 11.64					

It is obvious from the data that the pre-treatment *A. pallens* population on jujube foliage 100^{-1} varied from 1.1 to 1.94, which was above the ETL level. After different treatments of insecticides that population was reduced in all the treatments with three different applications of sprays viz; 15th May, 15th June and 15th July, respectively. Maximum reduction in the population was achieved after the second spray (15th June); the population of *A. pallens* reduced below the ETL (1.3 *A. pallens* 100^{-1} leaves) with Lorsben (0.47) and Radiant (0.64)

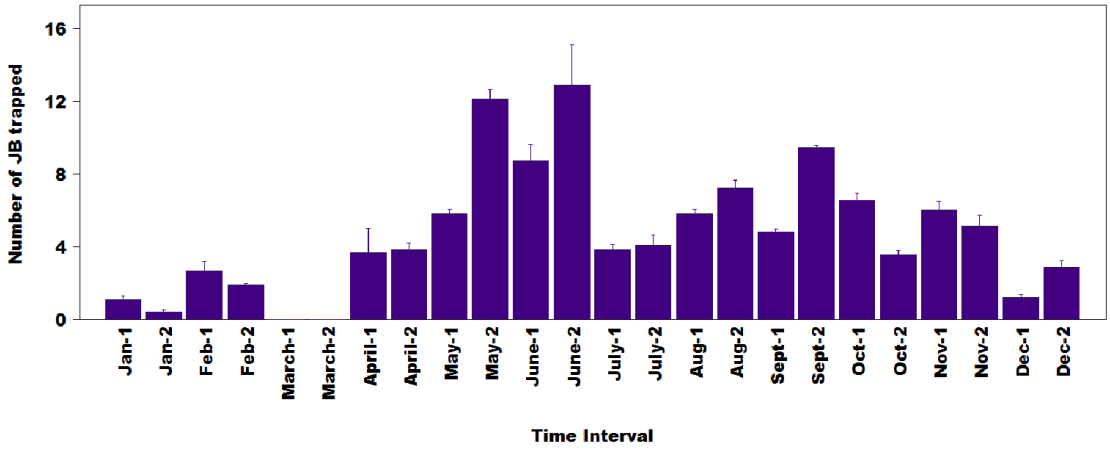

Figure 1. Light trapped mean population of *A. pallens* moth recorded during 2007 and 2008 (Note. JB = Jujube beetle)

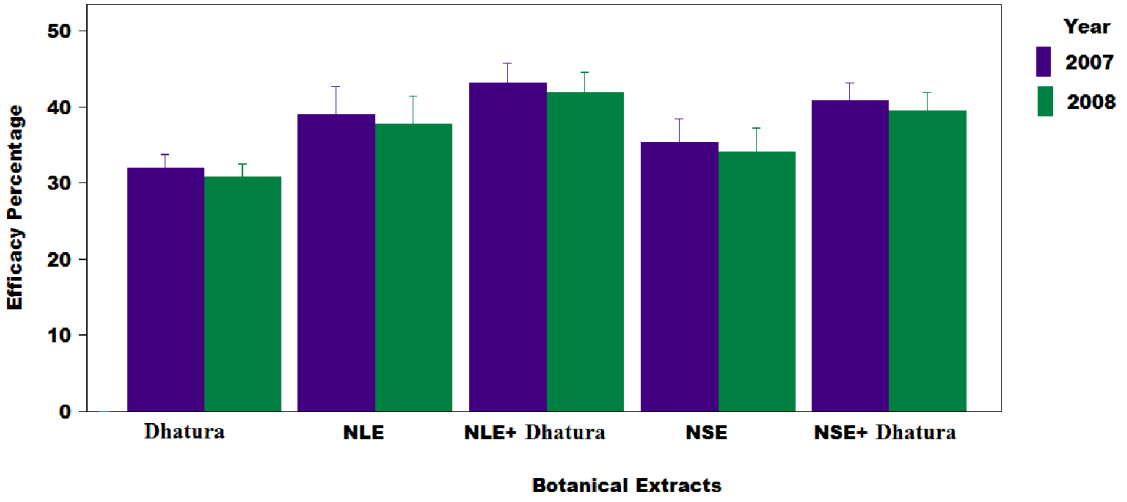

Figure 2. Efficacy of different botanical extracts (Mean ± SE) against *A. pallens* in field conditions of jujube (Note. NLE = Neem Leaf Extract; NSE = Neem Seed Extract)

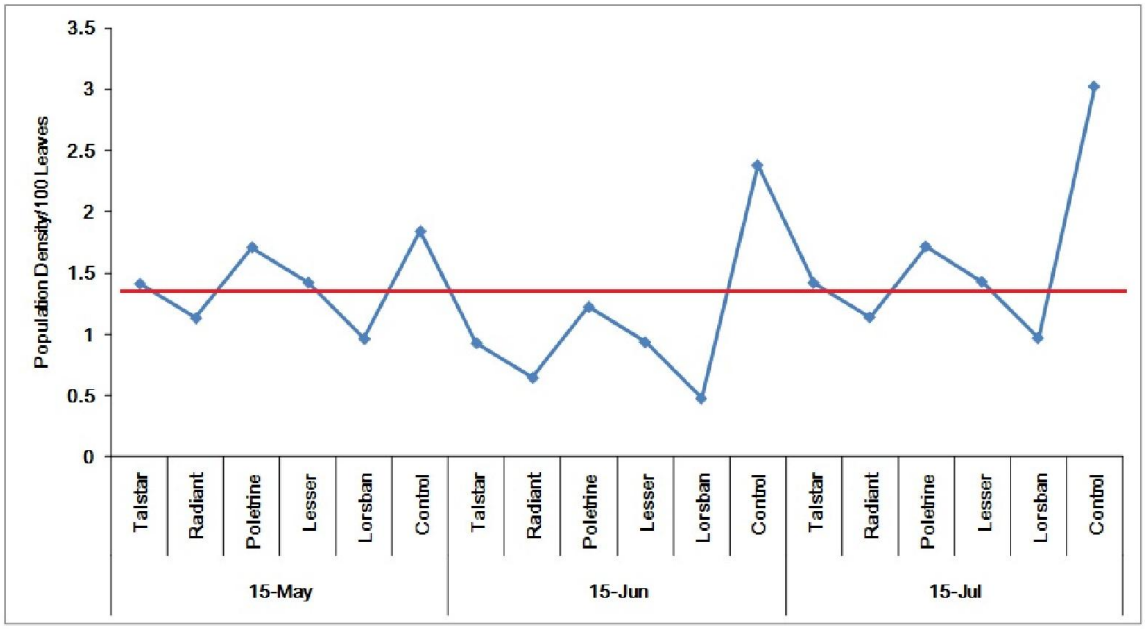

Figure 3. Efficacy of different commercial insecticides (Mean ± SE) against *A. pallens* in field conditions of jujube (Note. The red coloured line showing the ETL (1.3 *A. pallens* 100^{-1} leaves) of *A. pallens*)

followed by Talstar (0.92) and Laser (0.93), respectively, compared to control plot (2.37 *A. pallens* 100^{-1} leaves). However, Lorsben followed by Radiant had the lower population compared to Talstar and Laser. The efficacy of Talstar, Laser and Polytrine-C was observed poor in which the population of *A. pallens* (1.42, 1.42 and $1.71/100^{-1}$ leaves) after third spray was observed above the ETL (Figure 3)

DISCUSSION

The main focus of current study has been given to develop the integrated pest management (IPM) model of jujube beetle. In this regards, various IPM approaches viz, light trap, botanicals and insecticides have been evaluated for the *A. pallens* at orchard of Tando Qaiser, Hyderabad. The achievements of current study are discussed in the light of reported line hereunder: The light trap is one of best tool the monitoring of insect, simultaneously, an easiest way for the capturing of nocturnal insect pest. It is obvious from the statistical analysis that maximum mean population of *A. pallens* was trapped on 30th June and 30th May with no significant difference followed by 30th September, 15th June and 30th August. The population of *A. pallens* was observed lower in the month of December, January and February of years, 2007 and 2008. The beetles have been reported to be trapped by using of light and killed by dropping them into water containing kerosene (Williams, 2006).

The use of plants and plant part extracts is also cheapest and safest way of insect pest control. The use of neem tree for the control of insect pests and other disease is well documented. Here we used different formulation of neem and Dhatura alone (Neem Leaf Extract, NLE; Neem Seed Extract, NSE; Dhatura) and in combination (NLE+Dhatura and NSE+Dhatura) to reduce the infestation of *A. pallens*. The results achieved on percentage reduction in *A. pallens* were significant with NSE followed by NSE+Dhatura and NLE+Dhatura indicates their higher efficacy. There are several reports for the use of plant extracts against various insect pests. It is also known that several essential oils of plant origin inhibit acetylcholine esterase activity in insects (Sridhar and Sulochana Chetty, 1989). They also reported that *Pongamia glabra* leaf extract contains fatty acid which is responsible for blocking the pores of the cellular membrane of the alimentary canal of *Euproctis fraterna* and reduction of growth and growth rates. The application of neem seed kernel extract (NSKE @ 5%) is also reported as an effective against jujube foliage pests (Singh, 2005).

The use of pesticides is no doubt dangerous for the agro-ecosystem as we all as for human and animal health. Due to WTO bindings we cannot export fruit, vegetable or any other Agricultural commodities those were contaminated with toxic residues of a particular pesticide, but here we used some pesticides on foliage (leaves) of the Jujube, so there were no any type of draw-back noticed. These injurious pesticides also suppressing/ limiting the population of beneficial; however, some time it is necessary to use these pesticides to reduce the insect pest population below the economic injury level as crop can be saved from huge economic losses. In the current study, we used some commercially available pesticides against *A. pallens*. The efficacy of Lorsben followed by Radiant was remained more effective, which reduced *A. pallens* population below the ETL. The efficacy of Talstar, Laser and Polytrine-C was observed poor in which the population of *A. pallens* after third spray was observed above the ETL. Several lines of research reports are available for the management of foliage insect pests of jujube with pesticides. The spray of 0.2% Carbaryl (50WP) and 0.05% Monocrotophos effectively control the jujube beetle (Pareek and Nath, 1996).

REFERENCES

Analytical Software, 2005. Statistix 8.1 user's manual, Tallahassee, FL.

Anbu, S., Balasubramanyan, S., Venkatesan, K., Selvarajan, M. and Duarisingh, R. 2009. Evaluation of Varieties and Standardization of Production Technologies in Ber (Zizi phus mauritiana) under Rainfed Vertisols. International Jujube Symposium, *Acta Horticulturae*; 840:55-60.

Bao, W., 2008. Good juju for jujubes *In:* China Daily, 2008-12-15. Downloaded on: 13-02-2014 (http://www. chinadaily.com.cn/bw/2008-2/15/content_7303562.htm).

DeKock, C. 2006. Uses. *In:* Ber and other jujubes. Fruits for the Future 2 (revised edition) Edited by Azam, A. S., Bonkoungou, E., Bowe, C., DeKock, C., Godara, A. and Williams, J.T. International Centre for Underutilized Crops, Southampton, UK.

Henderson, C.F. and E. W. Tilton 1955. Tests with acaricides against the brow wheat mite. *J. Econ. Entomol.,* 48:157-161.

Kassem, H.A. R.S. Al-Obeed, M.A. Ahmed and A.K.H. Omar. 2011. Productivity, Fruit Quality and Profitability of Jujube Trees Improvement by Preharvest Application of Agro-Chemicals. *Middle-East J. Sci. Res.,* 9 (5): 628-637, 2011

Khan, M.R. 1994. Insect pest management horticultural and forest crops. Pak. Agri. Res. Council (PARC) Islamabad, Pakistan. Pp. 400-408.

Padmanabhan, S., Vishwanatha, S., Narasimhamurthy, K., Rao, S.V. 1993. Effect of feeding ber (*Zizyphus mauritiana* Lam.) juice on growth, blood composite. *Int. J. Food Sci. Nutr.,* 44(2): 91-94.

Mann, G.S., Kansal, A.K. 1999. Development of Euproctis fraterna Moore on jujube *Zizyphus mauritania* Lamk. *Pest Manag. Econ. Zool.*, 41-2: 111-113.

Pareek, O. P. and V. Nath, 1996. Ber in Coordinated Fruit Research in Indian Arid Zone - A two decades profile (1976-1995). National Research Centre for Arid Horticulture, Bikaner, India. Pp. 9-30.

Shah, A.H., R.C. Jhala, Z.P. Patel, R.L. Patel and G.M. Patel. 1990. First record of some pest on ber *Zizyphus mauritania* Lamark cultivated in South Gujarat, India. *J. Entomol. Res*., 52(1): 161-163.

Sudheer MJ, Rao DM, Dayaniard T, Reddy NM, New record of tortoise beetle, Oceanside pudibenda (Boh.) on ber in Andhra Pradesh, Madras. Agric J., 1990; 77 2: 103-104.

Wen Hung Chick, Seasonal occurrence and chemical control of Indian jujube Jassid Amrasca devastans Dist. in Taiwan. *J Agri Res China* 1998; 47, 2: 135-141.

Williams JT, Agronomy In: Ber and other jujubes. Fruits for the Future 2 (revised edition) Edited by Azam-Ali S, Bonkoungou E, Bowe C, deKock C, Godara A and Williams JT, International Centre for Underutilized Crops, Southampton, UK, 2006, pp. 302.

****