MONITORING OF INSECT PESTS AND THEIR NATURAL ENEMIES ON BIODIESEL PLANT, *JATROPHA CURCAS* L.

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ABSTRACT : *The insect pests and their associated natural enemies on jatropha were monitored at three different experimental locations, i.e. nursery farm, student farm and research farm at ARI Tandojam. The observations were recorded twice a week from 1st September, 2010 till 30th May, 2011. The overall mean population of whitefly was highest (6.72/plant) at the student farm followed by the research farm (5.36/plant) and nursery farm (4.78/plant). Similarly, the overall mean population of jassid was maximum (6.42/plant) at the student farm followed by the research farm (5.61/plant) and the nursery farm (1.89/plant). The overall mean population of mealy bug was comparatively higher (0.64/plant) at nursery farm followed by the research farm (0.47/plant) and (0.22/plant) at student farm. In case of natural enemies, maximum population of spider (19.00/plant) was recorded at the student farm in the 1st fortnight of September 2010, research farm (12.50/plant) in 1st fortnight of November 2010. The overall seasonal population of spider was highest (9.47/plant) at the student farm followed by the research farm (6.33/plant) and (4.06 /plant) at the nursery farm. The population of predator, Brumus suturalis F. showed no consistency in the field of jatropha; however, the maximum population recorded at nursery farm (6.0/plant) followed by student farm (4.0/plant) and research farm (2.5/plant). It was concluded that the jassid and whitefly were recorded as major insect pests on jatropha while termite was related to soil condition. The pest populations showed an increasing trend with rising temperature; mealy bugs were rare in the jatropha field. However, the abundance of predatory spiders was noticed on the field of jatropha and the spider population indicated its association with the population of major insect pests such as jassid, white fly, mealy bug and termite.*

Keywords: Insect pests, Natural enemies, Biodiesel plant, *Jatropha curcas* L.

INTRODUCTION

The genus Jatropha contains 175 known species which belong to the family Euphorbiaceae [1]. Jatropha plant was originated in the Caribbean which was spread as an important hedge plant to Asia and Africa by Portuguese traders. The jatropha plants are succulent shrubs and known as drought-resistant with well recognition as a valuable bio-fuel crop. [2]. Some varieties of jatropha such as *J. integerrima*, *J. curcas* and *J. glanduli fera* are grown in South America and other varieties of *J. glandulifera*, *J. curcas*, *J. gossypifolia*, *J. multifida*, *J. integerrima*, *J. nana*, *J. tanjorensis* and *J. podagrica* are extensively cultivated [3]. The jatropha has drought tolerance and produces seeds which contain up to 40% oil that could be converted into jatropha bio-diesel after being refined [4]. Increasing demand and rising prices of petroleum would definitely result in an increase of the crude oil prices in the future. Due to these reasons, the researchers and governments are actively involved to find the alternatives of fuel source. Bio-diesel is only such alternative as several countries are projecting *Jatropha curcas* because this plant is obtaining significance as a low-cost alternative which is a major source of biofuel and also been advocated for the development of dry lands and wastelands. Presently, jatropha is emerging as most promising feedstock for which the industry can be established which may involve popularization, efforts in research, popularization and also to provide financial assistance to the entrepreneurs (Shitra and Dhyan, 2006) [5]. Based on the economic potentials of jatropha, people are being encouraged and an upsurge in growers of jatropha and their venture into a commercial farming has been observed on a large scale.

In particular, farmers are searching efficient insect pest management tactics (PCARRD, 2010) [6]. Grimm (1999) reviewed insect pest management of *Chrysocoris purpureus*, *Scuteller anobilis* and two scutellarid bug as pests of *J. curcas* [7]. In East Africa, at least, thrips (Thysanoptera; thripidae), mealy bugs (Homoptera; Pseuococcidae), blue bug (Hetereptera; Scutelleridae), cotton stainer bug (Hemiptera; Prryhocoridae), whiteflies (Hemiptera; Aleytrodidae), golden beetles (Chysomelidae; Alticanae) and wood mite is reported to devastate the population of jatropha. Therefore, studies were carried out on the monitoring of insect pests and their associated natural enemies on *Jatropha curcas* L. in Sindh, Pakistan.

MATERIALS AND METHODS

The experiments were carried out on the monitoring of insect pests and their associated natural enemies of bio-diesel plants, *Jatropha curcas* L from September 2010 to May 2011. Three different locations were used to conduct the experiments such as a Student farm of Sindh Agriculture University Tandojam, Research farm of Agriculture Research Institute, Tandojam and Nursery farm of the Agronomy Department, Sindh Agriculture University Tandojam. The data were recorded twice a week, which was started from 1st September, 2010 and lasted till 30th May, 2011. The major insect pests (jassids, whiteflies and mealy bugs) and their associated natural enemies (spiders and Brumus) were observed experimental plantations of jatropha. For sucking insects, total 5 leaves were randomly observed by selecting 2 leaves from the bottom, 2 from mid and 1 from the top of the plants. The identification of collected insects was done in the laboratory while the natural enemies of insect pests were also counted using the sweeping net.

Natural enemies (Spiders and Brumus)

The population of natural enemies was determined from the whole plants. The means of natural enemies' population were calculated.

RESULTS

Whitefly population

The population of whitefly started appearing from 1st September, 2010 to 30th May, 2011 (Table-1). Highest mean population of whitefly (19.00 /plant) was observed at student farm (Sindh agriculture University), followed by (14.50 /plant) at Research farm (Agriculture Research Institute, Tandojam) and (12.00 /plant) at nursery farm (Agronomy Department). However, the population of whitefly declined in the months of December, 2010 to 15th February, 2011 with its mean population of 0.00 to 3.00 /plant at every jatropha farm. The population of whitefly increased with the rise of temperature (31.24°C) and continued up to May 2011. The highest mean range of whitefly population (0-19 /plant) was observed on the student farm followed by (0.5-14.50 /plant) at research farm and (0-12/plant) at nursery farm. The data indicated that during the months of winter (December to February), the pest population remained low because of low temperature (14.41 °C). The overall maximum mean population of whitefly (6.72 /plant) was observed on student farm, followed by research farm (5.36 /plant), whereas it was minimum (4.78 /plant) at nursery farm. Statistically, significant differences were recorded in the population of whitefly ($P<0.05$) while between the observation dates non-significant ($P>0.05$) difference was recorded at the experimental sites.

Jassid population

The data on the population of jassid was present on jatropha plants during the entire period of experiment from 1st September, 2010 to 30th of May, 2011 as shown in (Table-2). The maximum mean population of jassid (15.5 /plant) was observed on research farm (ARI Tandojam), followed by 14.5 /plant at student farm, SAU Tandojam. However, the population of jassid declined during January 2011 to 15th March, 2011 with a mean population of 0.00 to 4.00 /plant on all farms of jatropha. A simultaneous increase in the population of jassid was observed with the rise in temperature (33.49 °C) and the peak population of jassid was observed on 30th May, 2011. During the period from 1st March to 30th May, 2011, the population of jassid was noticed in the range of 0.50 to 14.5 /plant at student farm and subsequently on research farm (2-15.5 /plant) and 0.5 to 8.5 /plant at nursery farm. The obtained data indicated that during the months of January, February and mid of March, the population of jassid decreased and later it increased; while the peak of population was recorded when the temperature was high (May, 2011). The overall data indicated that the maximum mean population of jassid (6.42 /plant) was recorded at the student farm of SAU, Tandojam, subsequently at the research farm of ARI, Tandojam (5.61 /plant) while it was noted minimum (1.89 /plant) at nursery farm of the Agronomy Department, SAU, Tandojam. The data indicate that the attack of jassid is more on mature plants of jatropha as compared to jatropha plants on nursery farm. This is evident from the population of jassid at nursery farm of the Agronomy Department, SAU, Tandojam when compared with the population of jassid at the student farm of SAU, Tandojam and research farm of ARI, Tandojam. Statistically, significant differences were observed in the population of jassid ($P<0.05$) between different observation dates as well as different experimental locations.

Termite population

The population of termite was present from the 1st fortnight of September, 2010 to 1st December, 2011 and later it was disappeared as shown in (Table-3). However, termites again appeared in the first week of March and remained in the field up to the harvest of the crop. Maximum mean population (15.00 /plant) was observed at research farm on 16 September, 2011, followed by (10.00 /plant) at student farm, However, the population of termite was absolutely absent at nursery farm throughout the experimental period. The termite population also remained absent at all experimental sites during December, 2010 to March, 2011. The overall mean data indicated that the maximum population of termite (4.63 /plant) was observed on research farm, followed by student farm (3.56 /plant) while it was minimum (0.00 /plant) on nursery farm at Agronomy Department. Statistically, the significant differences were recorded in the population of termite ($P<0.05$).

Mealy bug population

The data regarding mean population of mealy bug (Table-4) on the plantations of jatropha indicate that mealy bug population was remained minor during the experimental period (1st September, 2010 to 30th May, 2011). However, at student farm, SAU Tandojam the mealy bug remained from the 1st fortnight of January till 1st fortnight of May, 2011 (0.5-2.0 /plant); while at research farm of ARI Tandojam the mealy bug appearance was noticed from the the 1st fortnight of October, 2010 (2.0 /plant); whereas at nursery farm of the Agronomy Department, SAU Tandojam, the population of mealy bug was recorded on the nursery of jatropha from 1st fortnight of November, 2010 (1.0 /plant).

The overall mean population of mealy bug on the plantations of jatropha was comparatively higher (0.64 /plant) at nursery farm of the Agronomy Department, SAU Tandojam, followed by research farm of ARI Tandojam (0.47 /plant); although the overall population was lowest (0.22 /plant) on jatropha at the student farm of SAU Tandojam. It appears that, jatropha is may not be among the plants preferred by mealy bugs in experimental areas, because the mealy bug population was not observed general, as it was recorded in the case of jassid or whitefly. Statistically, there was no significant difference in the population of mealy bug ($P>0.05$) between the dates of observations as well as experimental locations.

Natural enemies (Spiders)

The data showed that population of spider was present in the plantations of jatropha throughout the experimental period (1st September, 2010 to 30th May, 2011) at all the three experimental sites (Table-5). The maximum mean population of spider (19 /plant) was observed on the student farm (SAU, Tandojam), followed by highest mean population of spider at the research farm of ARI Tandojam (12.5 /plant); whereas the maximum population of spider was recorded at nursery farm of the Agronomy Department, SAU, Tandojam was (8 /plant). Irrespective of experimental location, the population of spider was higher from 1st September 2010 till 1st January 2011 (2-

19 /plant). However, the population of spider declined during January, 2011 to 15th February, 2011 with means population of 0.00 to 6.50 /plant at all jatropha farms. There was a simultaneous increase in the spider population with rising temperature and spider populations reached to 18.00, 12.00 and 8.00 /plant at student farm SAU, Tandojam, Research farm ARI, Tandojam and Nursery farm, Department of Agronomy SAU, Tandojam, respectively. Even from the last observation of 30th May, 2011, the population of spider at all experimental locations was 16.5, 9.00 and 5.5 /plant, respectively. The overall seasonal population of spider at the student farm of SAU, Tandojam was highest (9.47 /plant), followed by research farm of ARI, Tandojam (6.33 /plant) while it was lowest (4.06 /plant) at the nursery farm of the Agronomy Department, SAU, Tandojam. Statistically, significant differences were recorded in the spider population ($P<0.05$) between experimental sites as well as between observation dates. During observations of spiders the species were recorded as *Cheiracanahium danieli*, *Aculepeira ceoropegia*, *Thyene imperialis*, *Lycosa mackenziei*, *Cheiracanthium melanostomum*, *Oxyopess alticus*, *Heteropoda nilgirina*, *Thomisus projectus*, *Thomisus albens*, *Lycosa tista*, *Pardosa pseudoannulata*, *Hippasa agelenoides* and *Pardosa birmanicae*.

Population of predator, *Brumus suturalis* F.

The data (Table-6) indicate that the mean population of predator, *Brumus suturalis* F. were recorded in the field of jatropha, student farm, the population of predator was present from 1st September to 30th May, 2011 (0-4 /plant); while at research farm of ARI Tandojam, the predator population also remained present from 1st September, 2010 till 30th May, 2011 (0.5-2.5 /plant). However, at nursery farm of the Agronomy Department, SAU, Tandojam, the *Brumus suturalis* F. appeared on the 1st fortnight of September, 2010 (6 /plant) and remained with less population till April, 2011. The overall mean population of predator, *Brumus suturalis* F. on the plantations of jatropha was comparatively higher (1.25 /plant) at research farm, followed by student farm (0.94 /plant); whereas the overall population was lowest (0.56 /plant) on jatropha at nursery farm. Statistically, the significant differences were recorded in the population of predators, *Brumus suturalis* F. ($P>0.05$) between observation dates and experimental locations.

DISCUSSION

Jatropha plant has more potential to produce bio-diesel because the rising prices of petroleum and the greater demand of petroleum products would apparently result in increasing prices of crude oil in the rear future. Biodiesel from *Jatropha curcasis* one such alternative to mitigate the reliance on the regular consumption of diesel [8]. Feeling the significance of the situation, the *Jatropha curcasis* would become a potential prospect in the near future for the production of biodiesel. The results show that overall mean whitefly (6.72/plant) and jassid (6.42/ plant) population (during 1st September, 2010 to 30th May, 2011) was observed highest at student farm, while mealybug was observed rarely throughout the experimental period and its overall mean population was (0.64/plant) at nursery farm. Grimm and Maes (2006) observed *Pachycoris klugii* Burmeister (Heteroptera: Scutelleridae) and *Leptoglossus zonatus* (Dallas) (Het. Coreidae), as key insect pests of jatropha [9]; whereas Pant and Sharma (2006) found that bugs scutellarid bug, *Scutellaria baicalensis* has been the major insect pest of Jatropha in India [10]. Similarly, Shanker and Dhyani reported *Pachycoris klugii*, *Agonosoma trilineatum*, *Scutellaria baicalensis*, *Pempelia morosalis*, *Stomphastis thraustica*, *Achaea janata* and *Oxycetonia versicolor* are the major insect pests of jatropha and *Stegodyphus* sp., *Pseudotelenomus pachycoris*, *Beauveria bassiana*, *Metarhizium anisopliae* and *Leptoglossus zonatus* are reported some of their biological control agents [11]. Moreover, Ambika *et al*. found bugs *Scutellaria baicalensis* and *Chrysocoris purpureus* as the major insect pests of jatropha in India [12]. Kavitha *et al*. reported mites as major pests of jatropha [13]. In another study, Agsaoay reported that of the five identified insect pests attacking jatropha, three were confirmed as major pests such as, mealy bugs, aphids and cutworms [14]. Deepa *et al*. found that *Jatropha curcas* L. is attacked by a number of insect pests which may include *Pachycoris klugii*, *Agonosoma trilineatum*, *Scutellaria baicalensis*, *Pempelia morosalis*, *Stomphastis thraustica*, *Achaea janata* and *Oxycetonia versicolor*, while *Stegodyphus* sp., *Pseudotelenomus pachycoris*, *Beauveria bassiana* [15]. PCARRD reported some of the major insect pests of jatropha such as aphids, mealybugs and cutworms with an economic yield threshold of 12.75%, 15.29%, and 18.99%, respectively [6]. Moreover, the percent of prey population was decreased significantly when the values of mortality ranged from 50% to 60%. Among natural enemies, the overall population of seasonal spider at the student farm was highest (9.47/plant), whereas the population of lady beetle, *Brumus suturalis* F. did not show consistency. In case of farms at two separate locations, the overall mean population (1.25/plant) was comparatively higher at research farm, while at the student farm mean population was 0.94/plant. However, the abundance of predatory spiders was noticed in the field of jatropha and their population showed affiliation with the population of major insect pests such as, jassid and white fly. Lady beetle, *Brumus suturalis* F. was also noticed rarely in the field of jatropha. The present results are partly supported by FACT (2010) who noticed *Microplitis maculipennis* as larval parasitoid and *Trichogramma evanescens* as an egg parasitoid on jatropha [16]. The difference in natural enemies and insect pests monitored in the current study with regard to other studies reported from various parts of the world may be associated with numerous varieties of jatropha, management practices and environmental conditions

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TABLES

Table-1: Fortnightly mean population of whitefly on *Jatropha curcas* L.

Obs. Date/Fortnight	No. of Plants Observed	Student Farm	Research Farm	Nursery at Agronomy Department
01.09.2010	30	11.5	5.0	12.0
16.09.2010	30	6.5	6.5	10.0
01.10.2010	30	19.0	14.5	5.5
16.10.2010	30	11.0	13.5	4.0
01.11.2010	30	10.0	12.0	6.0
16.11.2010	30	12.0	8.0	2.5
01.12.2010	30	5.0	4.0	2.0
16.12.2010	30	3.0	2.5	1.5
01.01.2011	30	2.5	2.5	3.0
16-01-2011	30	0.0	2.5	1.5
01.02.2011	30	0.0	0.5	0.5
16.02.2011	30	0.0	0.5	2.0
01.03.2011	30	1.0	3.5	0.0
16-03-2011	30	1.5	2.5	3.0
01.04.2011	30	12.0	4.0	12.0
16.04.2011	30	12.0	2.0	3.5
01.05.2011	30	6.0	4.0	11.5
16.05.2011	30	8.0	8.5	5.5
Average/plant		6.72	5.36	4.78

Table-2: Fortnightly mean population of jassid on *Jatropha curcas* L.

Obs. Date/Fortnight	No. of Plants Observed	Student Farm	Research Farm	Nursery at Agronomy Department
01.09.2010	30	0.0	3.0	0.0
15.09.2010	30	2.5	0.0	0.0
01.10.2010	30	11.0	13.5	5.0
15.10.2010	30	11.5	11.5	7.5
01.11.2010	30	7.0	7.5	7.0
15.11.2010	30	9.0	4.5	8.5
01.12.2010	30	12.0	7.5	0.0
15.12.2010	30	11.0	11.0	0.5
01.01.2011	30	4.0	3.0	0.0
15-01-2011	30	0.0	1.5	0.0
01.02.2011	30	1.5	0.0	0.0
15.02.2011	30	0.0	0.5	0.0
01.03.2011	30	1.5	2.0	0.0
15-03-2011	30	0.5	3.5	1.5
01.04.2011	30	12.0	6.5	1.5
15.04.2011	30	8.5	3.0	0.5
01.05.2011	30	9.0	7.0	1.5
15.05.2011	30	14.5	15.5	0.5
Average/plant		6.42	5.61	1.89

Table-3: Fortnightly mean population of termites on *Jatropha curcas* L.

Obs. Date/fortnight	No. of Plants Observed	Student Farm	Research Farm	Nursery at Agronomy Department
01.09.2010	30	10.00	13.33	0.0
16.09.2010	30	8.33	15.00	0.0
01.10.2010	30	6.67	10.00	0.0
16.10.2010	30	5.00	8.33	0.0
01.11.2010	30	2.50	10.00	0.0
16.11.2010	30	2.20	0.00	0.0
01.12.2010	30	2.93	0.00	0.0
16.12.2010	30	0.00	0.00	0.0
01.01.2011	30	0.00	0.00	0.0
16.01.2011	30	0.00	0.00	0.0
01.02.2011	30	0.00	0.00	0.0
16.02.2011	30	0.00	0.00	0.0
01.03.2011	30	9.60	0.00	0.0
16.03.2011	30	5.17	0.00	0.0
01.04.2011	30	4.17	11.67	0.0
16.04.2011	30	3.17	6.67	0.0
01.05.2011	30	2.50	5.00	0.0
16.05.2011	30	1.83	3.33	0.0
Average/plant		3.56	4.63	0.0

Table-4: Fortnightly mean population of mealy bug on *Jatropha curcas* L.

Obs. Date/fortnight	No. of Plants Observed	Student Farm	Research Farm	Nursery at Agronomy Department
01.09.2010	30	0.0	0.0	0.0
16.09.2010	30	0.0	0.0	0.0
01.10.2010	30	0.0	2.0	0.0
16.10.2010	30	0.0	0.0	0.0
01.11.2010	30	0.0	1.0	1.0
16.11.2010	30	0.0	0.0	0.0
01.12.2010	30	0.0	1.5	1.0
16.12.2010	30	0.0	0.0	0.5
01.01.2011	30	0.5	0.0	0.0
16.01.2011	30	0.0	0.5	0.0
01.02.2011	30	1.0	3.5	0.0
16.02.2011	30	0.0	0.0	0.5
01.03.2011	30	0.0	0.0	0.0
16.03.2011	30	0.5	0.0	2.0
01.04.2011	30	0.0	0.0	0.0
16.04.2011	30	0.0	0.0	0.0
01.05.2011	30	2.0	0.0	6.0
16.05.2011	30	0.0	0.0	0.5
Average/plant		0.22	0.47	0.64

Table-5: Fortnightly mean population of spiders on *Jatropha curcas* L.

Obs. Date/fortnight	No. of Plants Observed	Student Farm	Research Farm	Nursery at Agronomy Department
01.09.2010	30	19.0	6.0	6.0
16.09.2010	30	15.0	11.0	7.0
01.10.2010	30	17.5	11.0	7.0
16.10.2010	30	19.0	8.0	3.0
01.11.2010	30	13.0	12.5	4.0
16.11.2010	30	6.5	4.0	3.5
01.12.2010	30	4.0	4.5	6.0
16.12.2010	30	5.0	4.0	4.5
01.01.2011	30	6.5	5.0	2.0
16.01.2011	30	0.0	3.5	3.5
01.02.2011	30	1.0	1.0	0.5
16.02.2011	30	0.0	0.0	2.5
01.03.2011	30	2.5	6.5	0.0
16.03.2011	30	1.0	4.5	3.5
01.04.2011	30	14.0	7.5	4.0
16.04.2011	30	12.0	4.0	2.5
01.05.2011	30	18.0	12.0	8.0
16.05.2011	30	16.5	9.0	5.5
Average/plant		9.47	6.33	4.06

Table-6. Fortnightly mean population of predator, *Brumus suturalis* F. on *Jatropha curcas* L.

Obs. Date/fortnight	No. of Plants Observed	Student Farm	Research Farm	Nursery at Agronomy Department
01.09.2010	30	4.0	2.5	6.0
16.09.2010	30	1.0	2.5	1.5
01.10.2010	30	0.0	2.0	0.0
16.10.2010	30	2.0	1.5	0.5
01.11.2010	30	2.0	2.5	0.0
16.11.2010	30	2.0	1.0	0.5
01.12.2010	30	0.5	0.0	0.0
16.12.2010	30	0.0	1.0	0.0
01.01.2011	30	1.0	0.0	0.0
16.01.2011	30	0.0	0.0	0.0
01.02.2011	30	0.5	0.5	0.0
16.02.2011	30	0.0	0.0	0.0
01.03.2011	30	2.0	1.0	0.0
16.03.2011	30	1.0	2.0	0.5
01.04.2011	30	0.0	0.0	0.0
16.04.2011	30	0.5	2.5	1.0
01.05.2011	30	0.0	1.0	0.0
16.05.2011	30	0.5	2.5	0.0
Average/plant		0.94	1.25	0.56

CONCLUSION

The population of whitefly and jassid showed an increasing trend with rising temperatures. Predatory spiders were recorded in abundance in the field of jatropha and the spider population was found to be associated with the major insect pests population i.e. white fly, jassid, termite and mealy bug. The lady beetle, *Brumus suturalis* F. was found rare in the field of jatropha while the attack of termite was recorded in less irrigated plants. The base of present results we need more study should be carried out round the year. To avoid termite

attack proper irrigation is recommended. For sucking insect pest application of recommended pesticide is suggested.

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