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A Novel Approach to Determine the Efficacy of Control Measures Against Dubas Bug, *Ommatissus lybicus* de Berg, on Date Palms

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أسلوب مبتكر لتحديد كفاءة عملية مكافحة حشرة دوباس النخيل

الملخص : حتى يمكن تحديد ضرورة الرش بالمبيد ضد حشرة دوباس النخيل ، من الضرورة أن يتم تحديد درجة الإصابة بالآفة . ثانيا : إذا وضح ان المكافحة ضرورية ، فيجب أ، يتم تقييم كفاءة عملية الرش بالمبيدات . يمكن هذين الأمرين بحساب عدد الحشرات على الأوراق ، يتستغرق هذا الأسلوب وقتا طويلا وله مخاطر عدة ويحتاج إلى عمالة مكثفة ، في هذه الدراسة تم وصف أسلوب بديل يقوم على أساس جمع وحساب قطرات الندوة العسلية التي تنتجها الحشرة. يستخدم في هذا الأسلوب ورق حساس للماء وذلك لجمع وحساب القطرات. تمت مقارنة هذا الأسلوب بالأساليب التقليدية ووجد أن هناك درجة ارتباط معنوية بينهما. أن الأسلوب الجديد فعال وسريع واكثر سهولة ولا يحتاج إلى عمالة مكثفة. وقد تم تبنيه لتقييم كفاءة عملية المكافحة.

ABSTRACT: In order to determine whether pesticide application against *Ommatissus lybicus* is required, it is necessary to monitor the severity of infestation by the pest. Secondly, if control measures are deemed necessary, then the efficacy of the pesticide application needs to be assessed. Both these parameters can be gauged by counting the number of insects on a leaflet. This method is time-consuming, hazardous and labor-intensive. A new alternative method based on collecting and counting honeydew droplets produced by the insect is described. Water sensitive paper is used to collect and count the droplets. This method is compared with the conventional technique and a significant correlation was found between the two methods. This new method is effective, rapid, less hazardous and saves labor. It has now been adopted to assess the efficacy of control measures.

Dubas bug, *Ommatissus lybicus* de Berg (Homoptera: Tropidduchidae), is a well known insect attacking date palm, *Phoenix dactylifera*. The pest has been recorded in Iraq, Iran, United Arab Emirates, Saudi Arabia, Kuwait, Bahrain, Sultanate of Oman, Egypt, Algeria and more recently in Sudan (EL-Haidari and Al-Hafidh, 1986).

The nymphs and adult of Dubas bug feed on date palm leaves and produce copious amounts of honeydew. This profuse feeding weakens the palm and the honeydew produced by the insect covers the leaves and the fruit. This layer of honeydew is an ideal substrate for saprophytic fungi. The sooty mold that grows on the honeydew reduces the photosynthetic activities of the leaves. This, in turn reduces the yield of the palm. Secondly, the quality of the date fruit is reduced. Hence, the effect of the honeydew is twofold: it reduces the yield of the palm and lowers the grade of the crop.

Economic losses of up to 50% have been recorded in Iraq due to the attach on date palms by this insect (Kranz *et al.*, 1978), necessitating control measures. In Oman the actual losses have not been determined, but the severity of attack indicates that losses must be considerable. In view of the severe attack, it is necessary to undertake chemical control of the pest. To date, this

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is the only effective means to reduce losses below the economic level. In the Sultanate of Oman, date palms have been regularly sprayed against the pest on an annual basis. This control operation is completely subsidized by the government.

In order to assess the efficacy of chemical control it is necessary to monitor the population of Dubas bug before and after spraying. This monitoring depends on visual counts of the insects *in situ*. The method is not satisfactory as it is confined to date palms that are easily accessible, viz. those that are two to three meters high or to suckers under the canopy of the palms. It should be pointed out that high numbers of the pest are located high up in the crown of the palms. Therefore, estimating the population of the pest by visual counts on short palms or on suckers does not reflect the actual situation of the density of the insect. Moreover, in order to inspect the palms for the insect it is necessary to bend down the fronds. Such an action disturbs the nymphs and the adults of the Dubas bug which then jump off the rachis. As a result the population of the pest is underestimated. In addition, it is not easy to handle the date palm fronds owing to the presence of stiff thorns at their bases. In view of the above, it was necessary to improve on the technique to monitor the population of Dubas bug.

In the present paper, a new technique to monitor the population of Dubas bug is described. It is based on collecting droplets of honeydew produced by the nymphs and aduts of the insect. The amount of honeydew produced by the insects reflects the population of the Dubas bug. It is this correlation which is exploited in the investigation reported here.

Materials And Methods

In order to compare the performance of this new technique with the conventional method of visual count of the insect (VCI) on the leaves, two field trials were conducted at different places during October 1989 and in October 1990 as follows :

OCTOBER 1989 TRIAL: This trial was carried out to test the significance of the correlation between the number of honeydew droplets produced by the insect and the VCI technique. Five villages with date palms infested with Dubas bug were selected for the trial. Four of these villages were in Wadi Beni Ghafet, Rustaq and the fifth was at Darseit, Muscat. Each village was demarcated into five sectors. Four of these sectors represented cardinal points, while the fifth sector was the middle of the grove. In each sector four date palms were selected at random and marked with a spray paint. Then four rachises from each palm were similarly marked. From each marked rachis, five leaflets were examined and the number of Dubas bugs was counted *in situ*. This visual count was done very carefully so as to minimize any disturbances to the insects.

For the purpose of counting the number of honeydew droplets secreted by the insects, strips of water sensitive paper (WSP), measuring 76 mm in length and 26 mm in width, were placed in disposable Petri dishes. The dishes were covered and distributed on the ground under the date palms at a distance of 1.5 to 2 meters from the trunk. Four Petri dishes were distributed under the palms, one in each sector of the compass. The Petri dishes were then opened and the strips of WSP exposed for a period of two hours, from 11:20 hours to 13:20 hours. At the end of the exposure time the strips of WSP were protected by covering with self-adhesive transparent tape on the sensitive surface and the Petri dishes were covered. In this way the strips were not damaged or smeared by water drops or finger prints during handling. Information relating to date, exposure time, name of the location and site number were enclosed with the strip. The Petri dishes were then sealed and transported to the laboratory for analysis. In the laboratory the number of honeydew droplets was counted. Such strips can be stored in a dry place for a long period of time.

OCTOBER 1990 TRIAL: The trial of the previous year demonstrated that WSP could be used to assess the infestation of Dubas bug on date palms. It was then necessary to establish if this new technique could be used to assess the efficacy of aerial spraying in controlling the pest. For this purpose twelve villages in different regions of the Sultanate were selected (Table 2) and strips of WSP distributed under the date palm groves as described above. However, the exposure time was increased to three hours, from 09:00 hours to 12:00 hours. In the laboratory it was necessary to use hand lens so as to differentiate droplets in juxtaposition. For each village twenty such strips were evaluated. Similarly, the conventional VCI technique was undertaken in order to verify the results. A total of 400 leaflets were examined for each village. In order to evaluate the efficacy of control measures it was necessary to determine the infestation of the Dubas bug before and after the spray operation. For this purpose data were gathered two days before the spray operation, and again five days after the application of the pesticide. The insecticide used during the spray operation was dichlorvos 50% and was applied at the rate of 3.75 l/ha.

Results and Discussion

The mean number of honeydew drops, as collected by the WSP, reflects the number of Dubas bugs as determined by the conventional method of VCI (Table 1). The mean number of honeydew droplets ranged

TABLE 1

Comparison between the number of honeydew droplets recorded by water sensitive paper (WSP) and the number of Dubas bugs per leaflet.

Village	Droplets/strip	Insects/leaflet
Tayyib	90.5	10.2
Yieka	18.8	3.0
Rejla	99.0	24.0
Sini	81.3	14.7
Darseit	15.0	2.3

from 15.0 (Darseit) to 99.0 (Rejla). Likewise, the mean number of insects per leaflet ranged from 2.30 (Darseit) to 24.0 (Rejla). Thus the technique based on counting the number of honeydew droplets reflected the population of the insect as documented by the VCI method. Statistical analysis of the data confirmed that there was a positive correlation ($r=0.686$ at $P<0.05$) between the number of honeydew droplets produced by the insect and the number of insects that were counted on the leaflets.

In assessing the efficacy of aerial spraying, the results obtained by using the WSP technique to count honeydew droplets were similar to those obtained by actual counting of the number of insects (Table 2). Again, the mean number of honeydew droplets ranged from 29.15 (Wadi Sakat) to 476.35 (El-Khatwa). This indicated that the lowest population of Dubas bug was at Wadi Sakat, while the highest population was at El-Khatwa (two days before aerial spraying). These results were confirmed by the actual counts of the insect where the mean number of insects was 0.52 and 16.32 for Wadi Sakat and El-Khatwa, respectively. Five days after the pesticide application, these values were 0.6 and 191.1 for the WSP technique, and 0.01 and 5.87 for the VCI at the two places. The correlation between the two methods was positive giving the value of $r=0.629$ ($P<0.05$) two days before the control measures. The correlation was even better five days after the application of the pesticide ($r=0.869$, $P<0.01$). Thus the number of honeydew droplets impinging on WSP was greatly reduced five days later following aerial application of the insecticide. This reduction ranged from 64% at El-Khatwa to 98% at Wadi Sakat. This observation was confirmed by the visual counts of the insects. Thus the data presented here indicates that counts of honeydew droplets on WSP can be used as a measure of the population of the pest.

Previous experience has shown that if the population reduction of *O. lybicus* is less that 90% five days after aerial spraying, then there is a rapid build-up of the pest during the following spring (unpublished data). For this reason, the efficacy of pesticide application has been placed at 90% reduction in the pest population. It would, therefore, appear that only at El-Khatwa this percentage has not been achieved based on the VCI method (Table 2). Based on the data obtained by using WSP, however, five villages viz. El-Khatwa, El-Zahir, Menah-Kamel, Mongared, and Waset, recorded population reductions of less than 90% following aerial spraying.

Three other villages, Katana, Adam-Sana and Wadi Quriyat, recorded percentage reductions close to

TABLE 2

Efficacy of aerial spraying against Dubas bug by assessing the honeydew produced by the insect in comparison with the visual count of the pest.

Village	Honeydew droplets per strip 2 dbt*	Honeydew droplets per strip 5 dat '	Reduction (%)	Insects per leaflet 2 dbt	Insects per leaflet 5 dat	Reduction (%)
Hormozi	370	26	93	9.0	0.8	91
Raihani	194	16	92	9.0	0.6	94
Katana	31	3	90	2.0	0.1	95
El-Khatwa	476	191	60	16.3	5.9	64
El-Zahir	415	65	84	14.0	1.0	92
Adam-Sana	82	8	90	3.7	0.2	94
Menah Kamel	33	4	89	3.2	0.1	96
Wadi Quriyat	72	8	90	3.3	0.2	94
Mongared	103	15	86	7.3	0.6	92
Ndab	31	3	92	1.4	0.1	95
Wadi Sakat	29	1	98	0.5	0.01	98
Waset	34	5	86	3.3	0.2	95

* dbt = days before pesticide application; $r=0.629$ at $P<0.05$

' dat = days after pesticide application; $r = 0.869$ at $P<0.01$

this value. Thus the conventional VCI technique tends to over-estimate the efficacy of control measures. This over-estimation can be explained by the fact that the insects tend to jump off the leaflet when disturbed and this cannot be avoided during the VCI operation. If the population of the pest is low then the bias tends to be magnified. This is true following aerial spraying. On the other hand, assessment of the pest population based on the WSP technique reflects a situation closer to the actual population of the pest in the field. Furthermore, it takes into account those insects found in the crown of date palms.

Inference of the size of insect populations based on the magnitude of their products or effects are often referred to as population indices. The relationship of these indices to the absolute population varies from equivalence to more general as estimated by the extent of damage. Thus the population of leopard moth *Zeuzera pyrina* was determined by counting the number of exuviae which protruded from the exit holes of the adult moths (Mokhtar, 1978). This is a case of equivalence. Southwood (1978) stated that the pellets of insect feces were first used as an index of both population and insect damage by a number of forest entomologists in Germany.

Honeydew droplets have been used as an index of aphid population. Thus Ehrhardt (1965) collected honeydew as droplets onto a waxed surface or glass plate placed beneath an aphid colony. Banks and Macaulay (1964) developed a more convenient method by accumulating honeydew droplets in a light oil over a period of time.

In earlier attempts to develop the present WSP technique, different methods of collecting honeydew droplets were investigated. Initially, a rectangular piece of transparent glass was used to collect honeydew droplets on its surface. In order to visualize and count the honeydew droplets, the glass plate was heated to caramelize the sugar content of the droplets. This technique was not satisfactory. To improve on this technique, a blank film slide was used as a receiving surface for the honeydew droplets. Although this was an improvement, it was difficult to keep the droplets from being smeared during the handling in the field.

In 1989 special WSP strips, which were used to calibrate pesticide sprayers, became available. On testing these paper strips in the collection and counting of honeydew droplets, they were found to be suitable. Owing to their moisture content, the honeydew droplets changed the color of WSP from yellow to blue. Thus the droplets were recorded as tiny specks of blue on a yellow background and were thus easy to count. This technique opened the way for assessing the population of Dubas bug quickly and efficiently throughout the Sultanate of Oman. The assessment of Dubas bug was carried out by both the conventional means and by this new technique described in the present paper. It was found that the new technique confirmed the results of the conventional method of assessing the pest density. It has now become a common practice to use this method in the evaluation of the population of Dubas bug in the field. The technique has also been useful in reaching a decision regarding the necessity to spray against the pest. It has saved many hours of laborious and sometimes hazardous field work for the determination of the density of the pest and the efficacy of control measures.

Conclusion

In order to control the Dubas bug two parameters should be determined. First, it is essential to determine the density of the pest thus reaching a decision whether chemical intervention is needed. Second, if control measures are required, to test the efficacy of the pesticide application. These assessments used to be carried out by visual count of the insect in the field. Such a technique did not include the insects high up in the crown of the palms. Furthermore it is labor-intensive and hazardous. In addition, it could under-estimate the density of the pest due to the disturbance of the insect during the operation. On the other hand, the density of the pest can be inferred from the amount of honeydew produced by the insect. This approach is exploited in the present publication. Water sensitive paper is used to collect and count the number of honeydew droplets produced by the insect. This technique is useful for the determination of the areas severely infested with Dubas bug thus in need of treatment with insecticides and the aerial spray operation. Secondly, it is effective in the assessment of the efficacy of the control operation. This technique is rapid, efficient, less hazardous and saves labor.

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