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# Aphid Oat *Rhopalosiphum padi* (L.) as an Economic Aphid Insect Vectors of Barley Yellow Dwarf Virus in Wheat Fields.

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## ABSTRACT

In the course of the transmission experiment carried out in the present work, the author pointed out a *Rhopalosiphum padi* (L.) transmitting the virus causing barley yellow dwarf disease (BYDV) from infect wheat plants to celery plants and from infected celery plants to healthy ones. It plays an important role in spreading the barley yellow dwarf virus in wheat cultivations in Sharkia Governorate, Egypt. The results of insect transmission experiment could be summarized as follows: The acquisition threshold feeding periods ranged between 1 hr and 24 hr. Incubation periods in insects ranged between 48 - 73 hr. , while in the host plants were 18 to 22 days in celery plants.

**Keywords**: aphid, wheat plant, barley yellow dwarf virus, *Rhopalosiphum padi* (L.)

## INTRODUCTION

Barley yellow dwarf virus is an economic important disease in wheat cultivations, it has been received great attention from plant pathology and entomologist in various countries. In this study of soft red winter wheat, the goal is to quantify the relationship between the time of infection and incidence of BYDV and effects on yield, Keith *et al.,* (2000). Response of winter wheat cultivars to barley yellow dwarf virus infection Carrigan *et al.,* (1981). Barley yellow dwarf incidence and wheat yield loss were significantly correlated with *R. padi* peak abundance and aphid-day accumulation on the crop. Based on transmission assays, *R. padi* was primarily responsible for vectoring the predominant virus serotype (PAV) they found in wheat, Jay *et al.,* (2001). Barley yellow dwarf viruses (BYDV) are economically important viruses that infect cereal crops worldwide. These viruses are transmitted only by aphids Du *et al.,* (2007). Yellow dwarf is a major disease problem of wheat, *Triticum aestivum* L., in Alabama and is estimated to cause yield loss of 21-42 bu/acre, Hadi, *et al.,* (2011). Aphids insects are responsible for the natural spread of barley yellow dwarf virus in wheat cultivations Hegab- Ola (2001). Data obtained from survey studies showed that *R. padi* individuals are the most abundant aphid insects inability wheat cultivation in Sharkia Governorate. Therefore it is reasonable to test the ability of the aphid, *R. padi* in transmitting the virus causing barley yellow dwarf disease.

## MATERIALS AND METHODS

Individuals of aphid, *R. padi* were collected from wheat cultivations in different regions at Sharkia Governorate. The collected individuals aphid insects were tested to make sure that they are free from any contaminating pathogens by placing them directly after collection from fields on healthy celery plants for 5-7 weeks (the experimental period) and the test plants were kept under observation. Microisolators were especially constructed to ensure the continuous stay of the aphids on the host plant throughout the periods of acquisition and inoculation feeding Hegab (1981) and Hegab-Ola (2001). individuals of aphid were classified into different groups according to the length of the acquisition feeding periods on infected wheat plants with the barley yellow dwarf virus

In order to confirm the ability and the efficiency of *R. padi* is an important vector of this virus in wheat cultivation, subsequent transmission was carried out from artificially infected celery plants (showing clear symptoms) to healthy ones.

In both acquisition and inoculation feeding periods, (5-10) aphids individual were placed on each plant using 3 plants (replicates) for each treatment. The acquisition feeding period ranged between one hour to 5 days .The inoculation feeding period lasted for 5-7 weeks, during which, aphids were transferred to healthy celery plants one after the other and the plants were kept under observation in the laboratory for symptoms development. In both acquisition and inoculation feeding periods. To determine the length of the virus is latent period in the insects after acquisition the agents, the insects were transferred at intervals to fresh healthy celery plants and the plants were kept under observation in the laboratory for symptoms development. These studies were carried out in the laboratory of Plant Protection Research institute Agriculture, branch in Shrakia

## RESULTS AND DISCUSSION

The primary experiments results showed that the aphid *R. padi* was the only species which proved to transmit barley yellow dwarf virus from infected wheat plants to healthy celery plants (as indicator plants) .

The results of barley yellow dwarf virus transmission from infected wheat plants to healthy celery plants by *R. padi* are shown in Table (1).These results clearly indicated that individuals of the aphid under consideration which fed on the infected wheat plants only for 30 min. failed to transmit the virus of the barley yellow dwarf virus.

The shortest acquisition feeding period for *R. padi* on infected wheat plants was 1 hr, after which they became infectious and capable to transmit the pathogen. The transmission ability of *R. padi* increased by prolonging the acquisition feeding period to 5 days Tables (1) and (2) after which efficiency of transmission was constant with increasing, the acquisition feeding period to 5 days.

The results also indicated that, the infectious *R. padi* were not capable to induce infection except after a latent period of 48 - 73 hr.

Subsequent transmission of barley yellow dwarf virus by *R. padi* was also obtained from infected celery plants to healthy ones Table (2). Data confirmed that the shortest acquisition feeding period for *R. padi* on infected celery plants was 1 hr. and the transmission ability increased by prolonging the acquisition feeding period to one day after which the ability of barley yellow dwarf virus transmission was constant with increasing the acquisition feeding period to 5 days. The results also indicated that the latent period of pathogen in the tested vector ranged from 48 - 73 hr. and also confirmed that the length of latent period decreased gradually by prolonging the acquisition feeding period Tables (2).

In general, it can be conclude that the *R. padi* was able to transmit barley yellow dwarf virus from infected wheat plants to healthy celery and from infected celery to healthy celery plants.

Symptoms appeared on celery plants within of 18 - 22 days it after inoculation of the agent. In comparison with their control, the leaves of diseased celery plants were faint yellowish green blotches near the leaf tip. The blotches enlarge rapidly and merge changing to shades of bright yellow. The infected plants appear smaller in size, while the characteristic symptoms on diseased wheat plants is dwarfed and the faint yellowish green blotches near the leaf tip enlarge rapidly changing from yellow to red. The symptoms generally appear first on the older leaves of young plants.

Sadeghi *et al.,* (1997), reported that the vector efficiency of twenty *R. padi* clones, originating from Europe, North America and North Africa and exhibiting different type of life cycle, was evaluated by transmitting a French barley yellow dwarf virus (BYDV) isolate to barley plants. Differences between clones in transmission efficiency were found only when a short acquisition access period AAP was followed by a long inoculation access period IAP (6 hr. / 120 hr.) respectively and to some extent when long AAP (48 hr.) was followed by long IAP (48 hr/120 hr).

Gray *et al.,* (1998) who mentioned that barley yellow dwarf virus is recognized as an important disease problem in winter wheat production in South of United States. The mean vector was *R. padi, Sitobion avenae and Schizaphis graminum* Harrington *et al.,* (1998) and Carver *et al*., (1999) reported that *R. padi, S. avenae* were the main vector of BYDV in the United Kingdom.

Haack *et al*., (1999) who showed that *R. padi* and *S. avenae* were the main vector to (BYDV) strain respectively and for both virus strains 100% infection was obtained in maize plants inoculated at the 2, 4 and 6 leaf stages, the percentage of infection decreased drastically for (BYDV) and more slowly for (BYDV) in plant inoculated at an older stage. Moon Jae Sun *et al.,* (2000) mentioned that *R. padi* was the main vector of BYDV in Illinois.

Hegab-Ola (2001)) who reported that *R. padi* is a vector transmitting Barley yellow dwarf virus. The results of insect transmission experiment could be summarized as follows: The acquisition threshold feeding periods ranged between 1 hr and 3 days. Incubation periods in insects ranged between 34 - 96 hr. Inoculation threshold feeding periods ranged between 1 - 6 hr. Incubation periods in the host plants were 24 to 32 days in celery plants and 28 - 42 days in wheat plants. Retention periods of the virus in the infective aphid vector *Rhopalosiphum padi* ranged between 56 - 112 hr.

Fabre *et al*., (2006) the population dynamics model is proposed to improve integrated pest management strategies against the aphid *R. padi*, the main Barley yellow dwarf virus (BYDV) vector in winter cereals during autumn in Europe. The model is based on a temperature-dependent simulation of *R. padi* population dynamics. The model requires a single early assessment of the proportion of plants infested by aphids. To account for sampling errors and for uncertainty caused by the numerous factors acting on aphid population dynamics under field conditions, Bayesian statistical inference was used. The model allows assessment of the probability distribution of the area under the curve of the percentage of plants infested by *R. padi* during autumn, a predictor of the need for insecticide sprays against BYDV vectors. The use of this model as a basis for a user-friendly decision support system improving BYDV management is discussed.

Jaros *et al.,* (2013) studied that throughout 3 years of experimental monitoring of BYDV incidence was the most frequently occurring species infecting cereals and grasses in the Czech Republic. Furthermore, *R. maidis* and *Metopolophium dirhodum* were recorded as BYDV vectors, even though *M. dirhodum* does not usually transmit BYDV. In field experiments with barley and wheat, where virus accumulation, symptoms and effect on the yield were tested. Infection with the BYDV isolate resulted in greater expression of symptoms and also in a greater reduction in plant height and grain weight per spike

**Table 1. Transmission of barley yellow dwarf virus (B.Y.D.V.) from infected wheat plant to healthy celery plants by aphid isects *Rhopalosiphum padi*.**

| Acquisition feeding period | % efficiency of virus transmission from infected wheat plants to celery plant | Range of latent period in | |
|---|---|---|---|
| | | an insect vector (hr) | an indicator plant (day) |
| 00 mn | 00 | 00 | 00 |
| 30 mn | 00 | 00 | 00 |
| 60 mn | 33% | 73 | 22 |
| 120 mn | 33% | 66 | 22 |
| 4 hr. | 33% | 60 | 20-21 |
| 8 hr. | 33% | 48 | 20 |
| 12 hr. | 33% | 52 | 18 |
| 16 hr. | 33% | 48 | 18 |
| 1 day | 66% | 48 | 18 |
| 2 day | 66% | 64 | 17 |
| 3 day | 66% | 80 | 16-17 |
| 4 day | 66% | 104 | 16 |
| 5 day | 66% | 128 | 15-16 |

**Table 2. Transmission of barley yellow dwarf virus (B.Y.D.V.) from infected celery plant to healthy ones by aphids *Rhopalosiphum padi.***

| Acquisition feeding period | % efficiency of virus transmission from infected celery plants to healthy ones | Range of latent period in an insect vector (hr) | Range of latent period in an indicator plant (day) |
|---|---|---|---|
| 00 mn | 00 | 00 | 00 |
| 30 mn | 00 | 00 | 00 |
| 60 mn | 33% | 73 | 22 |
| 120 mn | 33% | 66 | 22 |
| 4 hr. | 33% | 60 | 20-21 |
| 8 hr. | 33% | 48 | 20 |
| 12 hr. | 33% | 52 | 18 |
| 16 hr. | 33% | 48 | 18 |
| 1 day | 66% | 48 | 18 |
| 2 day | 66% | 64 | 17 |
| 3 day | 66% | 80 | 16-17 |
| 4 day | 66% | 104 | 16 |
| 5 day | 66% | 128 | 15-16 |

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## مقدرة حشرة من الشوفان *Rhopalosiphum pad* L. كحشرة ناقلة لفيرس التقزم الأصفر فى الشعير لنباتات القمح


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اختبار مقدرة بعض أنواع حشرات من الشوفان في نقل المسببات المرضية الفيروسية التى تصيب نباتات القمح (فيروس التقزم الأصفر فى الشعير). قد أوضحت نتائج تجربة نقل الفيروس المسبب لمرض التقزم الأصفر فى الشعير و الذى يصيب نباتات القمح بواسطة حشرة من الشوفان *Rhopalosiphum padi* على قدرة تلك الحشرة على نقل الفيروس من نباتات القمح المصاب الى نباتات الكرفس السليم (نباتات مختبرة) و من نباتات كرفس مصابه الى نباتات كرفس سليمة وقد بينت النتائج ان أقل فترة تغذية لازمة لاكتساب المسبب المرضى١-٣ يوم و اقل فترة لازمة لحقن المسبب المرضى داخل النبات المختبر ٨ ساعات. بينما وجد ان فترة الحضانة داخل الحشرة المختبرة ٤٨-٧٣ ساعة و فترة الحضانة داخل النبات المختبر١٨-٢٢ يوم.