Effect of Hydroxamic Acids in Wheat on BYDV Transmission by *Rhopalosiphum padi*

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The presence in a plant of internal resistance factors to virus vectors may diminish virus transmission (Gibson and Plumb, 1977). DIMBOA (2, 4-dihydroxy-7-methoxy-1, 4-benzoxazin-3-one), the main hydroxamic acid (Hx) present in wheat, has been associated with resistance of the plant to aphids through antibiosis and feeding deterrency (Niemeyer, 1988). This latter effect has been observed with aphids on wheat plants (Niemeyer et al., 1989) and on synthetic diets (Argadoña et al., 1983).

Studies with *Sitobion avenae* on oats showed that transmission of BYDV is effective when plant access periods longer than a given threshold occur (Scheller and Shukle, 1986).

This report shows that *Rhopalosiphum padi* takes a longer time to reach the phloem and is less able to transmit BYDV in wheat plants with higher Hx levels than in those with lower levels, and suggests that Hx may be used towards the prevention of virus transmission in wheat.

Materials and Methods

Six wheat lines with different DIMBOA levels (Platifen, 0.9 μmol/kg. fresh weight; Millaleu, 1.0; Mexifen, 1.3; Nobo, 1.4; Anza, 2.0; Maiten, 2.7) were used.

Feeding behavior of adult aphids was assessed through electropenetration graphs (EPG) (Tjallingii, 1988). For each cultivar studied, 20 adult aphids were wired and their feeding behavior recorded for 6 hours. The number of aphids reaching the phloem and the mean time to phloem ingestion were determined.

Viruliferous aphids were reared in oats infested with the PAV strain of the virus prevailing in Chile (Herrera, 1984; Webby et al., 1990). An aphid was allowed to feed for 6 hours on a wheat plant in the 1-leaf stage. The aphid was then transferred to an oat plant susceptible to BYDV and suppressed with insecticide 24 hours later. Viruses were allowed to develop for 1 month both in wheat and oat. Development of BYDV symptoms in oat plants revealed the virulence of the aphid concerned. Twenty aphids were examined for each cultivar chosen and the whole experiment was repeated three times. The presence of BYDV in plants was determined by means of an ELISA tests.

Hx analysis was carried out by high performance liquid chromatography (Niemeyer et al., 1989).

Results and Discussion

Figure 1 shows that more aphids reached the phloem and it took them less time to begin ingestion from it when DIMBOA levels were low than when they were high, suggesting that the presence of DIMBOA affected aphid settlement. Figure 1 also shows a negative correlation between DIMBOA levels and BYDV transmission. Hence, DIMBOA may be considered a resistance factor that causes a proportion of aphids searching suitable feeding tissue to continue probing but not feeding, and to die or leave the plant without transmitting viruses.

These results were obtained with wheat plants in the 1-leaf stage, when DIMBOA levels are highest. However, evidence for the possible role of DIMBOA in preventing BYDV transmission by aphids has been obtained with plants at a stage of development when natural aphid populations are high in the field. Thus, lines classified as tolerant to BYDV showed higher DIMBOA levels than those which were classified as susceptible to BYDV (Givovich and Niemeyer, 1991). The development of wheat cultivars possessing high DIMBOA levels throughout the plant's life or at least at growth stages when aphid populations are high seems desirable.

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References

Argadoña, V.H., L.J. Corcuera, B.C. Campbell and H.M. Niemeyer. 1983. Toxicity and feeding deterrency of hydroxamic acids from Graminae in synthetic diets against the greenbug, *Schizaphis graminum*. Entomol. Exp. Appl. 34: 134-139.

Gibson, R.W. and R.T. Plumb. 1977. Breeding plants for resistance to aphid infestation. In Harris, K.F. and K. Maramorosch, eds., Aphids as Virus Vectors, Academic Press, London, pp. 474-500.

Givovich, A. and H.M. Niemeyer. 1991. Hydroxamic acids affecting barley yellow dwarf virus transmission by the aphid *Rhopalosiphum padi*. Entomol. exp. eppl., in press.

Herrera, G. 1984. Purification and identification of a Chilean isolate of BYDV by ELISA. Agricultura Tecnica (Chile) 44: 283-286.

Niemeyer, H.M., 1988. Hydroxamic acids (4-hydroxy-1, 4-benzoxazin-3-ones), defence chemicals in the Graminae. Phytochemistry 27:3349-3358.

Niemeyer, H.M., E. Pesel, S. Franke and W. Francke. 1989. Ingestion of the benzoxazione DIMBOA from wheat plants by aphids. Phytochemistry 28: 2307-2310.

Scheller, H.V. and R.H. Shukle. 1986. Feeding behavior and transmission of barley yellow dwarf virus by *Sitobion avenae* on oats. Entomol. Exp. Appl. 40: 189-195.

Tjallingii, W.F. 1988. Electrical recording of stylet penetration activities. In Minks, A.L. and P. Harrewijn, eds. Aphids: Their Biology, Natural Enemies and Control, vol. B, Elsevier, Amsterdam, pp. 95-108.

Webby, G.N., R.M. Lister and P.A. Burnett. 1990. Survey of barley yellow dwarf viruses in bread wheat nurseries in South America during 1988 and 1989. Barley Yellow Dwarf Newsletter 3:20-22. Mexico, D.F.: CIMMYT.

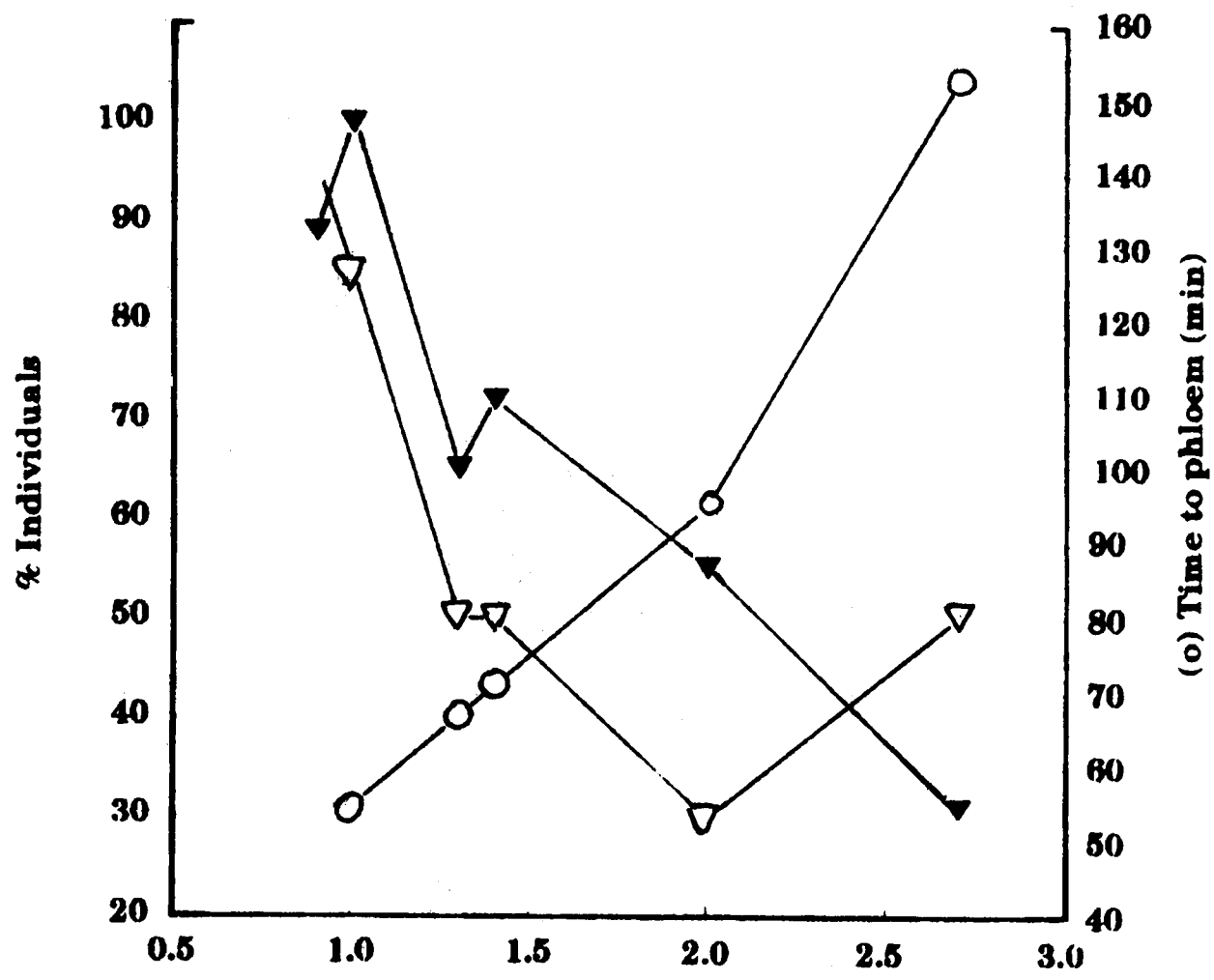

Figure 1. Effect of DIMBOA levels in seedlings of six wheat cultivars on percentage of aphids (Rhopalosiphum padi) arriving at the phoem with six hours (▽); time taken by aphids to begin phloem ingestion (○); percentage of plants infested with BYDV by viruliferous aphids (▼). For details , see Materials and Methods.