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Karyotype variation in the corn leaf aphid, *Rhopalosiphum maidis* (Fitch), species complex (Hemiptera: Aphididae) in relation to host-plant and morphology

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Abstract

Rhopalosiphum maidis (Fitch) collected on barley in the northern hemisphere usually has a ten-chromosome karyotype, whereas samples from maize, sorghum and Johnson grass (*Sorghum halepense*) from all parts of the world commonly have $2n = 8$. Samples with other karyotypes ($2n = 9$, $2n = 11$ and $2n = 8$ heterozygous for an interchange between the X chromosomes) occur less frequently on these and other species of Gramineae. Multivariate morphometric analysis, principally by the method of canonical variates, indicated that the ten-chromosome form may be regarded as a single clone of *R. maidis* recognizable by its karyotype and host-plant relationships, although not completely separable by morphology alone from all other clones of this permanently parthenogenetic species complex.

Introduction

The corn leaf aphid, *Rhopalosiphum maidis* (Fitch), is a pest of cereal crops throughout the world, transmitting viruses of barley, maize and sorghum. All populations seem to be entirely parthenogenetic; males are occasionally recorded, but in species of the genus *Rhopalosiphum* a functional sexual phase would probably involve migration to a woody, rosaceous primary host-plant, and there is no evidence that this occurs in *R. maidis* anywhere in the world. Populations of *R. maidis* therefore comprise an indefinable number of separate parthenogenetic lineages. Five of these lineages were isolated by workers in Kansas, USA, and described as 'biotypes', characterized mainly by their differing abilities to colonize varieties of barley and sorghum (Painter & Pathak, 1962; Wilde & Feese, 1973). It is not known whether these same biotypes are recognizable in other parts of the USA, or in other parts of the world. Steiner *et al.* (1985) found enzyme (esterase) differences between *R. maidis* samples collected in northern and southern USA.

Differences in karyotype between samples of *R. maidis* have been reported (Blackman & Eastop, 1984; Chattopadhay *et al.*, 1982). Preliminary studies of samples of *R. maidis* from various parts of the world provided evidence that certain karyotypes may be correlated with particular host-plant relationships and morphological characters, and this might lead to the recognition of separate taxonomic entities within the *R. maidis* complex on a worldwide basis (Blackman *et al.*, 1987).

In this paper, we analyse the different karyotypes of *R. maidis* in more detail and present results of a multivariate morphometric study of samples from all parts of the world.

We also examine the correlations between the karyotype and the morphology of a sample and the host-plant on which it was collected, and discuss their taxonomic significance.

Materials and methods

The karyotyped material comprised 110 samples of *R. maidis* from 18 countries in six continents (Table I). Aphids were preserved in 3:1 methanol:acetic acid. Embryos were dissected from two or three, usually immature, specimens of each sample, hydrolysed in hydrochloric acid and squashed in 45% propionic acid (see Blackman (1980) for details of method). Somatic cell nuclei in prometaphase or metaphase stages were photographed and the negative images projected onto graph paper in order to measure the relative lengths of individual chromosomes.

TABLE I. *Samples of* Rhopalosiphum maidis *karyotyped and/or measured*

Sample no.	No. of chromosomes	Host-plant	Locality	No. of measured specimens	
				Apterae	Alatae
1234	9*	"Grass"	New South Wales	5	—
1241	8	Sorghum	California	8	6
1541	8	Wheat	Iran	—	—
1977	8	?	Ivory Coast	—	4
2117	8*	Johnson grass	Portugal	5	7
2350	8	*Avena sterilis*	Portugal	10	—
2359	10	Barley	Montana	12	11
2361	10	Barley	Montana	13	8
250101	10	Barley (ex cult. 25°C, 16-h day)	England	24	23
250102	10	Barley (ex cult. 20°C, 16-h day)	England	23	21
250103	10	Barley (ex cult. 16°C, 12-h day)	England	24	23
250104	10	Barley (ex cult. 10°C, 12-h day)	England	19	24
250105	10	Barley (ex cult. 30°C, 16-h day)	England	24	24
2582	8	Maize	Botswana	7	14
2584	9*	Barley	Iran	—	—
2588	8*	Maize	Iran	29	—
2621	9*	"Grass"	Israel	—	—
2663	9*	Johnson grass	Uruguay	—	—
2677	8	Sorghum	Israel	—	—
2678	8	Sorghum	Israel	8	—
2684	10	Oat	Cyprus	—	—
2766	10	Barley	Quebec	14	9
2767	8	Barley (ex cult.)	Ontario	38	14
2792	8*	Sorghum	Israel	5	—
2809	11*	Maize	Iran	14	8
2814	8	Maize	Iran	12	4
2817	9*	Wheat	Iran	15	—
2829	8	Johnson grass	Uruguay	—	—
2834	8	Sorghum	Iran	—	—
2835	10	*Setaria viridis*	Iran	13	—
2836	8	Johnson grass	Iran	25	—
2839	8	Wheat	Jordan	—	—
2922	9*	*Echinochloa crus-galli*	Iran	13	—
2923	8	*Echinochloa crus-galli*	Iran	21	—
2924	8	Johnson grass	Iran	—	—
2925	9*	*Echinochloa crus-galli*	Iran	12	—
2944	8	*Echinochloa crus-galli*	Iran	—	—
2945	8	Maize or sorghum	Iran	—	—
2946	8	Maize	Iran	—	—
2949	8	Maize	Iran	20	5
3018	9*	*Pseudosasa japonica*?	New Zealand	—	—
3231	8	Maize	Tasmania	9	5
3274	9*	*Echinochloa crus-galli*	Tasmania	12	22
3307	8	Barley (ex cult.)	New York	19	—
3339	10	Barley	Washington	24	—
3489	8	Maize	Ohio	—	—
3490	8	Sorghum	Japan	12	—
3491	8	Sorghum	Japan	—	—
3492	8	Maize	Ohio	24	12
3507	8	Maize	Egypt	12	—
3508	8	Sorghum	Japan	13	12
3510	8	Maize	Egypt	13	—
3511	8	Maize	Egypt	12	—