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Wild and Cultivated Grasses of Poaceae as Parts of a Trophic Complex of Secondary Host Plants *Rhopalosiphum padi* (L) (Hemiptera: Sternorrhyncha: Aphididae)

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Abstract

The two-year measurements data of the developmental parameters of three ontogenetic morphs of a heteroecious holocyclic population of *R. padi* from Northwest Russia near St. Petersburg were determined for 11 wild species and eight cultivars of cereal grasses. On their basis, the plants were systematized into three groups according to the degree of their acceptability for colonization by the pest. Of the studied wild-grass species, *S. Viridis* was classified as the least suitable (potential) host of aphids, and *Ph. phleoides* and *A. arundinaceus* - as the most suitable. E. altissimus was not previously known as the *R. padi* host. Aphids have developed more successfully on cultivars than on the corresponding species of wild plants. The results obtained are recommended to be used to control the places of accumulation and expansion of the pest. The possibility of the influence of the host plants photosynthesis type on the development of aphids is assumed but requires special studies.

Disciplinary: Agricultural & Plant Sciences.

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1 Introduction

As a result of the appearance of herbaceous plants on the Earth, aphid-plant associations were changed by the appearance of alternation (heteroecy) of the woody (primary, winter) and summer herbaceous (secondary) host plants allowing to rapidly increase their numbers during the summer thanks to already available parthenogenesis (clonal population structure) and polymorphism (Dixon, 1990; Heie, 2004). Cereals are of great importance as secondary host plants of many aphid species. The study of fossil remains of bamboos and reeds, as well as modern molecular genetic studies, suggests that the ancient species of the Poales appeared in the mid-late Cretaceous (122-106 million years ago) during the split of the ancient continent of Gondwana. Global climate changes associated with an increase in continentality, insolation and decrease in humidity occurred during this period (Tsvelev, 1987; Belyuchenko, 2014; Goncharov et al., 2015). It is assumed that *Poaceae* belongs to the most progressive among flower plants (Goncharov et al., 2015). By the beginning of the Paleogene (56.0 million years ago), the diversity of cereals had increased significantly. Its divergence was accompanied by adaptation to dry conditions. A characteristic C_4-pathway (Kranz syndrome) of photosynthesis arose with increased productivity and economical moisture consumption (Tsvelev, 1987; Richard, 2002). The widespread distribution of *Poales* species occurred later- about 25 million years ago when extensive grass areas were formed (Tsvelev, 1987; Mordkovich, 2014). The cereals became members of trees – plant herbaceous – aphids complexes. The bird cherry-oat aphid *Rhopalosiphum padi* (Linnaeus, 1758) is one of the most important pests of cereals. This is a host-alternation aphid associated primarily with bird cherry *Padus avium* Mill. as usual for holocyclic clones. Plants of 110 species from 7 families are indicated as secondary hosts for *R. padi*. Anholocyclic clones occur in temperate areas with warm winter which remain on the secondary hosts without bisexual reproduction. Since the times of farming, many kinds of cereal have entered the diet of aphids so firmly that they were given the pest status not only as consumers but also by transmitting several viruses and phytoplasmas during migrations between secondary hosts. (Emden & Harrington, 2007; Smatas, 2006). Weeds and even cultivated cereal grasses as host plants of aphids are much less studied than cereals. However, recent interest in them has been increasing for several reasons: the importance of wild grasses as infections sources and as aphids wintering places; for keeping pests population in nutritional deterioration (after harvesting of spring crops, after use of chemical protective means, in urban conditions); when searching for plants to obtain extracts with protective properties; when studying the influence of allopathic relations between plants; on the development of aphids and entomophages; as a reserve for selection; in the study of the possibility of plants transition from C_3 — (wheat, rice) to more productive C_4 — the pathway of photosynthesis (Berezina & Afanasyeva, 2009; Bukharina & Dvoeglazova, 2010; Glinwood et al., 2003; Maiksteniene & Arlauskiene, 2006; Ninkovic, V., Pettersson, J. 2003). It is interesting to note that in recent years the C_4 - pathway of photosynthesis has been found in wheat grain, where aphids do not feed. (Rangan et al., 2016).

The largest number is represented by *Poaceae* species, including all major grain crops, to a lesser extent - Sedge (Cyperaceae), Rush (Juncaceae), Iris (Iridaceae) and Cattail (Typhaceae) (Finlay & Luck, 2011) Most often, wild plants are indicated as host plants for *R. padi* only as a result of collection and description of insect and host species. At the same time, testing plants for their suitability for aphid colonization is possible as a result of the identification of insect development characteristics. In particular, based on the analysis of the complex of primary and secondary host plants, we proposed a classification of forage plants for aphids, which includes: optimal, reduced suitability, tertiary, universal (reserve, neutral), potential or rare, random (Tsvelev, 1987).

This study looks for the possibility of *Rhopalosiphum padi* (L) development on wild and cultivated grasses of *Poaceae*.

2 Materials and Methods

The study was carried out with the bird cherry-oat aphid *R. padi* of a heteroecious holocyclic population from Northwest Russia near St. Petersburg. Aphids and plants were kept in covered wire mesh houses. After aphid colonization, the plants were covered with transparent fabric insulators. All plant samples in each of the experiments were colonized with aphids simultaneously.

The work was carried out for 2 years. Seed material was provided by the employees of the All-Union Research Institute of Plant Breeding (city of Saint-Petersburg) from the world collection (1st year) and CSBG SB RAS (city of Novosibirsk), collected in nature (2nd year). *Triticum aestivum L. var. lutescens* c. Leningradskaya 6 was a control. Reserve clones of *R. padi* were kept on wheat c. Leningradskaya 6 in isolation.

Table 1. Characteristics of species and cultivars of Poaceae

Cat. VIR	Species, cultivars	Distribution	Biological features, habitats, application
First-year			
40852	*Bromus inermis* (Leys)	Europe, North America.	Rhizome perennial. Meadows, banks of reservoirs. Cultivated.
34825	*B. inermis*cv. Lehis		
43483	*Alopecurus arundinaceus* Poir.	Commonly.	Rhizome perennial. Meadows. Cultivated.
34673	*A. arundinaceus* cv. Donskoy 20		
41809	*Dactylis glomerata* L.	In many extratropical regions of both hemispheres.	Loose tussock perennial Forest and forest-steppe. Cultivated.
48311	*Phleum pratense* L.	Widely in the temperate regions of the Northern hemisphere.	Rhizome perennial. Meadows, steppe. Cultivated.
20257	*Ph. pratense* cv. Leningradskaya 204		
51626	*Phleum phleoides* (L.)	Europe, Middle Asia, Mongolia.	Loose tussock perennial. Meadows, steppes, coniferous forest. Foraging cereal.
49050	*Poa pratensis*L. cv. Kartashevsky	Northern hemisphere, Australia, New Zealand	Loose tussock perennial with creeping underground shoots. Meadows, forest edges. Forage and lawn grass.
47301	*P. pratensis* cv. Conni		
36620	*F. pratensis* cv. VIK-5	Europe, Asia Minor	Rhizome perennial. Forests, forest-steppes, river floodplains. Forage grass.
51302	*Festuca rubra* L. cv. Virovskaya	Commonly.	Rhizome perennial. Meadows. Pasture and lawn grass, used in the design.
35059	*F. rubra* cv. Suidinskaya		
Second-year			
-	*Lamarcia aurea* (L.) Moench.	Mediterranean and West Asia	Multi-shoot annual plant. Dry sandy, stony slopes. Used in design.
-	*Elymus altissimus (Kong.) A. Love ex B. Rong L*	Asian part of Russia, Altai etc.	Tussock perennial. Forms a shrub, mountainous areas.
-	*Agropyron cristatum* (L.)	Eastern Europe, Siberia, Far East, Mongolia, China.	Rhizome perennial. Forms loose bushes. Steppes and forest-steppes. Not demanding on the soil.
-	*Elytrigia* sp. Desv.	Everywhere except deserts.	Rhizome perennial. Not demanding on the soil. Weed.
-	*Lagurus ovatus* L.	North Africa, Western Asia, Europe. Naturalized in many countries.	Annual. The panicles are very thick, glume thickly covered with long hairs. Sand coastal soils. Cultivated in design.
-	*Setaria viridis* (L.)	Everywhere in temperate and tropical regions.	Annual. Forms a shrub. Ruderal plant in Russia. Weed.

In the first year, the development of three *R. padi* morphs (emigrants, alate and apterous viviparae) was studied when feeding on plants of 5 wild species and 8 cultivars of *Poaceae* (Table 1) (Emden & Harrington, 2007). Plants were colonized by aphids during the tillering phase.

The emigrants were collected from – *P. avium* Mill. For this purpose, the insects were collected in small boxes with lids, 35 each. Then the boxes with the emigrants were opened and each was placed under an insulator in a vessel with plants of one or another specimen. A day later, the calculation of survived (I) and those who settled among the survived (II) emigrants was carried out. The experiment was carried out three times.

Further, 3 aphid clones were used. In all variants of experiments, each of the vessels with plants was colonized with 3 young females, one from each clone. In the case of emigrants (as well as apterous viviparae), the insect settling was checked the next day after the colonization of the plants. Otherwise, the aphids were replaced. The initial fecundity (during the first 5 days) (III), as well as the total number of individuals (P_{14}) (IV) and the number of winged larvae - (future alate) (V) - were determined 14 days after the start of reproduction of emigrants. The period from birth to the start of reproduction (further referred to as pre-reproductive period) (VI), the initial (5 days) fecundity rate (VII), P 14 (VIII) were recorded in of apterous viviparae; winged viviparae - the initial (5 days) fecundity reproduction rate (IX) – of alate viviparae. Determination of reproductive indicators in each variant was repeated 5 times. No less than 20 individuals on each plant sample assessed the pre-reproductive period (VI). For this purpose, adults of apterous viviparae were placed in vessels with plants, after a day they were removed, and the development of the larvae was monitored before reproduction beginning.

In the second year of research, the development parameters of *R. padi* morphs were determined for 6 wild species in the tillering phase, for *L. ovatus*. and *L. aurea* - in the flowering phase (Table 1). The P_{14} was assessed for emigrants (IV') and apterous viviparae (VIII'), the pre-reproductive period - for apterous viviparae (VI'). The experiments were carried out similarly to the previous ones.

To assess the acceptability of the plant sample for *R. padi* development, with simple but informative "sum of rankings" method that we described in detail (Vereschagina & Gandrabur 2016) was assessed. Division of all plants (species and cultivars) into three groups (favorable - high; moderately favorable - medium and unfavorable - low) was done based on the development parameters of aphid morphs (see above). The following parameters corresponded to the favorableness of plants: high survival rate and a high number of settled emigrants, short pre-reproductive period, the high initial rate of reproduction, high P_{14}, and a low number of winged larvae (assessment of the desire to leave the host). Each parameter was ranked (the place was determined) depending on its suitability for the morph development, starting from the least suitability. Next, the sum of the parameter ranks and its average value ("suitability index" - SI) were calculated for each plant sample. The values of the indices were also lined up depending on the suitability: the higher the value of the index, the more suitable the plant is for the *R. padi* development. Based on the indices, the group of plants' suitability was determined. These ranks were assigned based on a parameter range of $\pm 2/3\ S\bar{x}$ from the mean ($\bar{x} \pm 2/3\ S\bar{x}$). The group of grasses with SI $\geqslant \bar{x} + 2/3\ S\bar{x}$ was qualified as having low suitability and that with PI $\leqslant \bar{x} - 2/3\ S\bar{x}$ as having high performance. Intermediate SI values were designated as medium suitability.

The experimental results were also processed with ANOVA using the Statistica program (linear correlation).

3 Results

Our data have demonstrated the variation in the suitability of wild grasses for emigrants. One day after release the full survival rate of emigrants (from 35 individuals) was observed only on *B. inermis*, the lowest – on *D. glomerata*. Some emigrants died without starting to feed, some continued to migrate around the sieving gauze. All the survived emigrants settled on *A. arundinaceus* and *Ph. phleoides*, the smallest amount (54.5%) - on *B. inermis* (Table 2). When settling cultivars, incomplete survival of emigrants was also observed. Their highest mortality was found on *P. pratensis* cultivars (Kartashevsky and Conni). At the same time, all the survived emigrants settled on cultivars one day after plant colonization. The exception was the cultivar Leningradskaya 204 (*Ph. Pratense*) (Table 2).

Table 2: Development parameters of *Rhopalosiphum padi* L. emigrants feeding on cereal grasses (first year research)

Sample	I	II	III	IV	V
Br. inermis	*100*	54.5	22.4 ± 0.7	841 ± 163	26
Br. Inermis cv. Lehis	100	100	20.6 ± 0.9	1053 ± 124	20.5
Al. arundinaceus	60	100	20.0 ± 0.5	1000 ± 159	3.5
Al. Arundinaceus cv. Donskoi 20	100	100	19.0 ± 1.8	1121 ± 225	7.4
D. glomerata	45.5	60	9.6 ± 0.5	856 ± 92	14.3
P. pretense	58.3	42.9	13.2 ± 0.9	780 ± 125	8.9
Ph. Pretense cv. Leningradskaya 204	90	90	13.8 ± 13.8	914 ± 131	18.4
Ph. phleoides	83.3	100	20.2 ± 0.4	906 ± 115	5
P. pratensis cv. Kartashevsky	70	100	21.6 ± 1.1	1132 ± 211	1.2
Ph. pratensis cv. Conni	80	100	19.0 ± 0.7	836 ± 76	10.2
F. pratensis cv. VIK-5	100	100	19.6 ± 0.8	909 ± 118	8.4
F. rubra cv. Virovskaya	100	100	17.0 ± 0.9	595±102	7
F. rubra cv. Suidinskaya	90	100	17.4 ± 0.9	821±97	6.5
Wheat cv. Leningradskaya 6	100	100	19.6 ± 1.3	1230±227	27.8

Note: number of individuals one day after plant infestation, %: I – survived, II – settled among survived; III – initial (5 days) fecundity; IV – P_{14} (total number of individuals for 14 days of initial reproduction); V – number of winged larvae

The primary choice of specimens by emigrants may not correspond to the degree of their further colonization. A statistically significant relationship was found only between survived emigrants and initial (5 days) fecundity ($r = 0.55$; $p = 0.04$; $r^2 = 0.29$) (Figure 1).

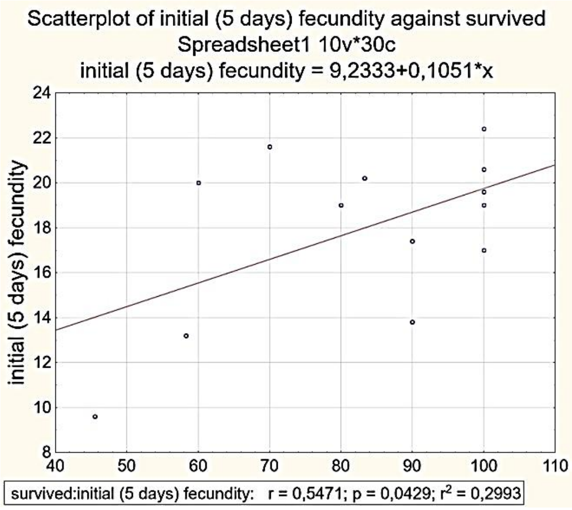

Figure 1: Correlation between survived emigrants and initial (5 days) fecundity *R. padi*

Duration of the pre-reproductive period of apterous viviparae increased from 8.2±0.4 days on *Ph. pratense* (cv. Leningradskaya 204) and *P. pratensis* (cv. Kartashevsky) up to 10.3±0.2 days on wild *B. inermis*. The initial volume of reproduction in different morphs decreased from 22.4±0.7 (wild *B. inermis* - emigrants) to 8.0±0.6 individuals, *F. pratensis* (cv. VIK5 - alate viviparae) (Tables 2 and 3).

Table 3: Development parameters of *Rhopalosiphum padi* L. of apterae and alate summer viviparae on cereal grasses (the first year of research)

Sample	VI	VII	VIII	IX
Br. inermis	10.3±0.1	13.7 ± 0.3	554±64	11.6±0.5
Br. Inermis cv. Lehis	9.5±0.2	15.6±0.5	738±119	11.0±0.7
Al. arundinaceus	10.1±0.3	11.0±1.3	714±98	9.3±0.7
Al. Arundinaceus cv. Donskoi 20	9.4±0.4	18.3±1.8	915±183	11.8±1.1
D. glomerata	9.1±0.2	8.8±0.8	952±181	5.7±0.6
Ph. pretense	9.8±0.1	10.4±0.9	501±75	9.4±0.5
Ph. pretense cv. Leningradskaya 204	8.2±0.1	11.0±0.9	630±106	9.4±0.6
Ph. phleoides	9.2±0.3	18.3±3.1	698±126	10.0±0.4
P. pratensis cv. Kartashevsky	8.2±0.4	20.1±1.4	420±73	10.8±1.1
P. pratensis cv. Conni	8.3±0.3	15.4±0.6	676±130	11.0±0.9
F. pratensis cv. VIK5	8.9±0.1	8.4 ±0.8	794±97	8.0±0.6
F. rubra cv. Virovskaya	8.9±0.1	10.0±0.7	430±66	11.2±0.6
F. rubra cv. Suidinskaya	9.0±0.1	9.8±0.6	549±104	9.0±0.7
Wheat cv. Leningradskaya 6	7.1±0.2	19.8±0.9	844±119	15.1±1.1

Note: VI – pre-reproductive period (dates); VII, IX – initial (5 days) fecundity of apterae and alate viviparae respectively; VIII – P_{14}

The maximum number of individuals for 14 days of reproduction was noted in emigrants on *P. pratensis* (v. Kartashevsky) and *A. arundinaceus* (v. Donskoy 20), minimal - in wingless summer viviparas - on *P. pratensis* (cv. Kartashevsky) and *F. rubra* (cv. Virovskaya). The proportion of winged larvae in the composition of aphid colonies did not have a significant relationship with their abundance ($r=0.21$; $p=0.5$; $r^2=0.04$).

As a result of the specimen ranking by all developmental parameters of *R. padi* different less suitability on wild grasses than their cultivars (Table 4). Nevertheless, *Ph. phleoides* and *A. arundinaceus* were noted as more suitable.

Table 4: Analysis of cereal grasses suitability for the development of *Rhopalosiphum padi* (L.) (first-year research)

Sample	I	II	III	VII	IX	VI	IV	V	VIII	Sum of rankings	I	Rank SI	Grass performance group
Bromus inermis	11.5	2	14	8	12	1	5	2	5	60.5	6.7	5	medium
Br. inermis cv. Lehis	11.5	9.5	12	10	9.5	4	11	3	10	80.5	8.9	11	high
Al. arundinaceus	3	9.5	10	5.5	4	2	10	13	9	66	7.3	7	medium
Al. arundinaceus cv. Donskoi 20	11.5	9.5	6.5	11.5	13	5	12	9	13	91	10.1	13	high
D. glomerata	1	3	1	2	1	7	6	5	14	40	4.4	2	low
P. pretense	2	1	2	7	5.5	3	2	7	3	32.5	3.6	1	low
Ph. pratense cv. Leningradskaya 204	7.5	4	3	5.5	5.5	12.5	9	4	6	57	6.3	4	medium
Ph. phleoides	6	9.5	11	11.5	7	6	7	12	8	78	8.7	10	medium
P. pratensis cv. Kartashevsky	4	9.5	13	14	8	12.5	13	14	1	89	9.9	12	high
Ph. pratensis cv. Conni	5	9.5	6.5	9	9.5	11	4	6	7	67.5	7.5	8	medium
F. pratensis cv. VIK-5	11.5	9.5	8.5	1	2	9.5	8	8	11	69	7.7	9	medium
F. rubra cv. Virovskaya	11.5	9.5	4	4	11	9.5	1	10	2	62.5	6.9	6	medium
F. rubra cv. Suidinskaya	7.5	9.5	5	3	3	8	3	11	4	54	6.0	3	low
Wheat cv. Leningradskaya 6	11.5	9.5	8.5	13	14	14	14	1	12	97.5	10.8	14	high

$\bar{X}$ (SI)=7.5; $S_{\bar{x}}$(SI)=2.1 SI≥8.9 – high; SI≤6.1 – low; intermediate SI values – medium
Note: Parameter numbers follow the same convention as that of table 2-3; SI – Suitability Index

Results of the second year of research showed that the largest total number of individuals for 14 days of initial reproduction was observed in emigrants on *Elytrigia* sp., the smallest - on *S. viridis*; in aptera viviparae - on *E. altissimus* and *S. viridis* (Table 5).

E. latissimus were distinguished by the highest initial rate of the fecundity of apterous viviparae, *S. viridis* – the lowest one. Both emigrants and apterous viviparae colonized hairs on glumes in general and reproduced more successfully on *L. ovatus* than on *L. aurea* (Table 5). Mostly, *S. viridis* proved to be the least suitable for reproduction of *R. padi*: emigrants tried to migrate for 3 days, reproduced poorly, small descendants, developed longer than on others hosts. Aphids preferred to feed in the tillering area on all grasses during the early days of reproduction on *S. viridis* — on abventitious roots sometimes. In the second year of research *E. altissimus* was the most suitable host (Table 5). During two years of research, aphids could reproduce up to the formation of the autumn remigrants on all specimens with the exception of *S. viridis*.

Table 5: Development parameters and analyses of cereal grasses suitability for *Rhopalosiphum padi* (L.) (second-year research)

Sample	Emigrants		Apterous viviparae				Sum of rankings	SI	Rank SI	Grass perfomanse group
	IV'	rank	VI'	rank	VIII'	rank				
Elymus altissimus (Kong.) A. Love ex B. Ron	364±58	5	9.4 ±0.2	6	1269±172	6	17	5.7	6	high
Elytrigia sp. Desv.	505± 89	6	10.0±0.1	5	782±87	5	16	5.3	5	medium
Agropyron cristatum (L.)	285±42	3	11.6±0.4	2	670±76	4	9	3.0	3	medium
Lagurus ovatus L.	359±57	4	10.6±0.3	4	469±69	3	11	3.7	4	medium
Setaria viridis (L.)	16±2	1	11.8±0.5	1	203±30	1	3	1	1	low
Lamarcia aurea (L.) Moench	74±9	2	10.8±0.5	3	274±48	2	7	2.3	2	low
Triticum aestivum L.	1042	7	8.3±0.2	7	1415	7	21	7	7	high

$\bar{X}$ (SI)=4.0; $S_{\bar{x}}$(SI)=2.1 SI≥5.4 – high; SI≤2.6 – low; intermediate SI values – medium
Note: IV' and VIII' – P_{14}; VI' – pre-reprodactive period

4 Discussion

Perennial cereal grasses capable of forming new above-ground shoots have firmly entered the *R. padi* host plant complex. However, their suitability for aphids has some features. In the north, where the primary host *P. avium* and spring crops are common, aphids holosyclic populations associated with grain crops as secondary hosts are prevalent. In the south, with a predominance of anholocyclic populations — cereal grasses and winter crops (Dixon, 1987). This work and earlier studies have shown that holocyclic *R. padi* can develop successfully on wild Cyperaceae, Juncaceae and Poaceae too (Vereschagina et al., 2017), although prefer spring wheat. (Vereshchagina & Prima, 2008).

In the first year of research, it was noted more successful development of *R. padi* on cultivars of grasses than on wild plants of the same species (Tables 2-4). Nevertheless, aphids development was recorded better on *Ph. phleoides* and *B. inermis*. This should be taken into account when identifying aphid accumulation, places, especially in late summer after spring crops harvesting. At the same time, the cultivation of such cultivars as Suidinskaya (*F. rubra*) and Leningradskaya 204 (*Ph. Pratense*) will *R. padi* development and Donskoy 20 (*A. arundinaceus*) and Kartashevsky (*P. pratensis*) will promote. The absence of a significant correlation between the number of aphid individuals (P_{14}) and the number of winged larvae reveals the influence on aphids resettlement not only of the density of colonies (Claflin et al., 2017), but also the poor suitability of the host, even with their relatively low reproduction.

In the second year of study, it was demonstrated the possibility of rapid *R. padi* reproduction on wild *E. altissimus* and *E. sp.*, which can become, like *Ph. phleoides* and *B. inermis*, sources of aphid expansion, especially during the period of autumn remigration. As it is widely known, the aphids migrations can be accompanied by the transfer of a viral infection. There is the possibility of aphid colonization of *L. ovatus* and *L. aurea* using in landscaping. Therefore attention required *E. altissimus* mentioned as the host of *R. padi* for the first time. According to our proposed classification of aphid host plants [20], experimental plant samples can be differed as optimal when *R. padi* fed during the entire growing season until autumn, but they varied by acceptability *S. viridis*, which aphids abandoned earlier should be considered as potential. Properties of *S. viridis* can be used to study allelopathic relationships of cereal plants in order to find new protective agents.

It is interesting to note the trophic relationship of *R. padi* recorded on a range of cultivated and wild secondary hosts in various ranges. For example, in Moldova, where *Zea mays* L. is widely grown and *Echinóchloa crus-galli* (L.) Beauv. is distributed as weed, aphids densely colonize plants of both species, which cannot be noted for northern latitudes (Vereshchagina & Vereshchagin, 2013). Such preferences sometimes lead to the formation of specific trophic forms in aphids. For example, in Chile, unlike other cereals, samples of *R. padi* were collected only on *Z. mays*, with a distinct set of genotypes (Rubio-Meléndez et al., 2019), *S. avenae* F. showed clones adapted to *D. glomerata* or Z. mays [9], *R. maidis* (Fitch.) - to barley or corn and sorghum [10]. Where in for *Z. mays*, *S. viridis*, *Ech. crus-galli*, many species of sedgies, as opposed to wheat, barley and *D. glomerata* is characterized by C_4— the pathway of photosynthesis (Speranskaya et al., 2013; Ivanishchev, 2017). Its importance in aphid feeding remains unexplored.

5 Conclusion

The development of *R. padi* when feeding on plants of 11 wild species and 8 cereal grass cultivars has been studied. Out of these, *E. latissimus* is first listed as host plants. Based on specimens systematization by parameters of aphids development, wild species are classified as less suitable, their cultivars - more suitable. Out of wild species, aphids colonized *Ph. phleoides* and *A. arundinaceus* better than others, the worst were *S. viridis,* where aphids did not live till the autumn remigration (potential host). *R. padi* also colonizes ornamental grasses (*L. ovatus* and *L. aurea*). The type of plant photosynthesis is reported as one of the reasons for the formation of different food forms in aphids for the first time. The conducted studies may be used to identify the spots of aphids reproduction and viral infection during pest management, control of intra-population diversification, including in dependencies on the photosynthesis type of the host plant.

6 Availability of Data and Material

Data can be made available by contacting the corresponding author.

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