during the summer. Being a warm-season grass, it was also dormant in the winter, irrespective of irrigation regimes. Nevertheless, its spring and fall growth allowed it to persist and compete with all invading species.

Time of year

We collected data in May, July, and December to target plant responses at critical times. May readings reflected the response to the winter and early spring months; July readings, response under high temperatures; and December readings, response during the winter, which identified dormancy of warm-season species.

Figure 2 presents responses of four species, with quite different growth patterns, to the three irrigation regimes and three times of year. Santa Ana bermudagrass showed little difference in performance among the three irrigation regimes in May and July. In December, there was a downward trend in performance, reflecting the growth cessation and approaching winter dormancy of this warm-season turfgrass.

Conversely, the growth pattern of Sirosa phalaris showed its summer dormancy with higher cover and quality ratings before (May) and after (December) dormancy.

Buffalograss performed similarly at all irrigation regimes. It clearly showed the dormancy pattern that characterizes the species during summer and winter months, despite the irrigation regime.

Glaucus saltbush showed less of a seasonal response than an irrigation response. This species performed better as a turf cover when irrigated at the 20% regime than at the 40 and 60% regimes.

Conclusions

Of the 27 turfgrasses and ground covers tested in this study, bermudagrasses and seashore Paspalum were the best performing turfgrasses under very low irrigation regimes. Two species of saltbush, buffalograss, and two varieties of *Phalaris* also gave comparatively good cover and quality.

This work showed that there are existing turfgrasses, and other plant material maintained as turf, that are capable of surviving and giving cover under extremely low irrigation regimes. These materials apparently resist the stress of low water application by various mechanisms, including dormancy, deep roots, and low rates of water use.

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Russian wheat aphid (green insect) and birdcherry oat aphid.

Suction trap reveals 60 wheat aphid species, including Russian wheat aphid

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Effective aphid pest management strategies depend on a knowledge of the economically important species present in an area and their flight behavior. A suction trap at UC Davis collected 60 aphid species, most of which are economically important. The trap detected the first specimens of the Russian wheat aphid found in northern California.

Aphids occur throughout the world on a wide variety of cultivated and wild plants. Many aphids cause economic damage through direct feeding, injection of toxins, transmission of plant pathogenic viruses, contamination with honeydew, or their presence on edible plant parts. They may attack any portion of the plant including leaves, stems, fruit, and roots.

Because aphids have adverse effects on many crops, are widely distributed, and reproduce rapidly, aphid control has been under investigation for many years. The introduction of biological control agents, such as lady beetles and syrphids, has not been practical in large-scale crop production, but the natural occurrence of these insects and fungal diseases or parasites has reduced aphid populations in such crops as sugarbeets. Adjusting planting dates to avoid a damaging infestation can be effective in barley, wheat, sugarbeets, and some other crops. Control by insecticides is effective, but is costly when repeated applications are needed. Insecticides usually do not control diseases caused by aphid-transmitted viruses, because the viruses are transmitted from the aphid to the plant during a short feeding period before the insecticide kills the aphid.

Trapping aphids

Monitoring aphid populations is a first step in developing crop management practices to minimize losses. Methods of determining the aphid species and numbers present include ground-level collection of flying aphids in pan traps, vacuum or sweeping techniques to remove aphids directly from plants, and direct counts of insects on plants. Aphids can also be collected at various distances above the soil surface with suction traps. In the western United

Aphid suction trap is part of the network of traps established in the western states.

States and in Europe, suction traps 28 feet above the surface have been effective in assessing seasonal aphid flights and in determining aphid numbers, which can be related to potential crop losses. None of these methods alone is sufficient to establish management decisions.

A network of more than 75 aphid suction traps established through the Western Region Integrated Pest Management project and various state agricultural experiment stations is now being used in the western United States and Canada. The suction trap was developed at the Washington State University Irrigated Agriculture Research and Extension Center. It has proved useful in detecting which aphid species were prevalent as vectors of the barley yellow dwarf virus, a generally distributed pathogen of small grains.

The traps have also been used to track the advance and the spring, summer, and fall migrations of the Russian wheat aphid, *Diuraphis noxia*, a new pest first found in the United States in 1986. Because of the need for information on economically important aphids, the system of traps has been expanded annually, most recently in California, where seven new traps were installed in late 1988. California's first trap was placed at the Agronomy Farm on the University of California Davis campus in 1987.

The results of the first year of monitoring aphid species from the Davis trap presented here demonstrate the variety of aphid species detected and their seasonal flight distributions. A sample was taken from the trap each week from February through November 1988 and assayed at the aphid laboratory at Prosser, Washington. The trap has already been useful in detecting the Russian wheat aphid for the first time in northern California.

Aphid species found in 1988

More than 60 species representing 37 genera were trapped, of which about 80% are economically important. The 10 most abundant species were birdcherry oat aphid (with 43.4% of total catch), pea aphid, green peach aphid, turnip aphid, potato aphid, greenbug, rice root aphid, mealy plum aphid, rose grass aphid, and green citrus aphid (fig. 1, table 1).

In the United States, 27 aphid species are capable of colonizing and feeding on small grains; at Davis, 12 cereal aphid species were detected. The predominant one was

TABLE 1. Winged cereal aphids, other economic aphids, and noneconomic aphids sampled by suction trap, Davis, California, February through November 1988

		No. of aphids trapped											Percent of:	
Scientific name	Common name	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Total	Total aphid catch	Cereal aphid catch
CEREAL APHIDS														
Aphis armoraciae	Western aster root aphid	0	0	1	1	0	0	0	0	1	0	3	<1.0	0.1
Anoecia corni	Dogwood aphid	0	0	0	0	0	0	0	0	1	0	1	<1.0	<0.1
Colopha ulmicola	[root feeding aphid]	0	0	0	0	0	0	0	0	1	0	1	<1.0	<0.1
Diuraphis noxia	Russian wheat aphid	0	0	0	2	2	5	0	0	0	0	9	<1.0	0.2
Metopolophium dirhodum	Rose grass aphid	0	0	34	39	2	0	0	0	0	0	75	1.0	1.9
Rhopalosiphum insertum	Apple grain aphid	1	0	0	1	0	0	1	1	1	0	5	<1.0	0.1
Rhopalosipum maidis	Corn leaf aphid	0	0	4	2	0	0	0	2	5	12	25	<1.0	0.6
Rhopalosiphum padi	Birdcherry oat aphid	408	1981	835	42	2	0	2	4	7	19	3300	43.4	85.6
R.rufiabdominalis	Rice root aphid	1	78	52	2	0	1	0	0	19	25	178	2.3	4.6
Schizaphis graminum	Greenbug	2	117	55	5	1	0	1	45	7	2	235	3.1	6.1
Sitobion avenae	English grain aphid	1	1	5	5	1	0	0	0	0	0	13	<1.0	0.3
Tetraneura ulmi	Elm grass root aphid	0	0	0	0	0	0	0	2	4	2	8	<1.0	0.2
	Subtotal	413	2177	986	99	8	6	4	54	46	60	3853	50.7	
OTHER ECONOMIC APHIDS														
Acyrthosiphum kondoi	Blue alfalfa aphid	0	0	36	9	0	0	0	0	0	0	45	<1.0	—
Acyrthosiphum lactucae	[vector/lettuce mosaic]	0	16	14	0	0	0	0	0	0	2	32	<1.0	—
Acyrthosiphum pisum	Pea aphid	1	33	224	23	1	0	0	39	215	231	767	10.1	—
Aphis craccivora	Cowpea aphid	4	17	18	5	3	3	1	0	0	0	51	<1.0	—
Aphis citricola	Green citrus aphid	2	48	0	0	0	0	0	2	0	0	52	<1.0	—
Aphis gossypii	Cotton aphid	0	32	0	0	0	0	0	0	0	0	32	<1.0	—
Aulacorthum solani	Foxglove aphid	0	1	9	8	0	0	0	0	0	0	18	<1.0	—
Brachycaudus helichrysi	Plum leafcurl aphid	0	2	27	15	0	0	0	0	0	0	44	<1.0	—
Brachycorynella asparagi	Asparagus aphid	0	0	0	0	0	0	0	4	13	3	20	<1.0	—
Brevicoryne brassicae	Cabbage aphid	0	0	0	1	0	0	0	0	0	0	1	<1.0	—
Cavariella aegopodii	Willow carrot aphid	0	0	8	2	1	0	0	0	0	0	11	<1.0	—
Dysaphis plantaginea	Rosy apple aphid	0	0	16	0	0	0	0	0	0	0	16	<1.0	—
Hyadaphis foeniculi	Honeysuckle aphid	0	0	0	0	1	0	0	1	1	0	3	<1.0	—
Hyalopterus pruni	Mealy plum aphid	0	0	20	56	1	0	0	0	3	3	83	1.1	—
Hyperomyzus lactucae	Black currant thistle aphid	0	0	2	4	1	0	0	0	0	0	7	<1.0	—
Lipaphis erysimi	Turnip aphid	1	105	103	9	2	1	3	4	18	6	252	3.3	—
Macrosiphum euphorbiae	Potato aphid	0	16	5	0	157	25	38	0	1	0	242	3.2	—
Myzus persicae	Green peach aphid	5	283	237	14	0	0	0	5	34	29	607	8.0	—
Nearactaphis bakeri	Short-beaked clover aphid	1	0	0	1	0	0	0	0	0	1	3	<1.0	—
Therioaphis maculata	Spotted alfalfa aphid	0	0	0	0	0	0	0	2	1	2	5	<1.0	—
	Subtotal	14	553	719	147	167	29	42	57	286	277	2291	30.1	—
ALL ECONOMIC APHIDS	**Subtotal**	427	2730	1705	246	175	35	46	109	330	337	6140	80.8	—
NONECONOMIC APHIDS	**Subtotal**	4	307	469	237	128	116	11	72	47	68	1459	19.2	—
ALL APHIDS	**TOTAL**	431	3037	2174	483	303	151	57	181	377	405	7599	—	—

The cream-colored stripes on wheat leaves are the most characteristic symptom of damage by Russian wheat aphid. Leaves later curl in a corkscrew fashion and resemble onion leaves.

Jack Kelly Clark

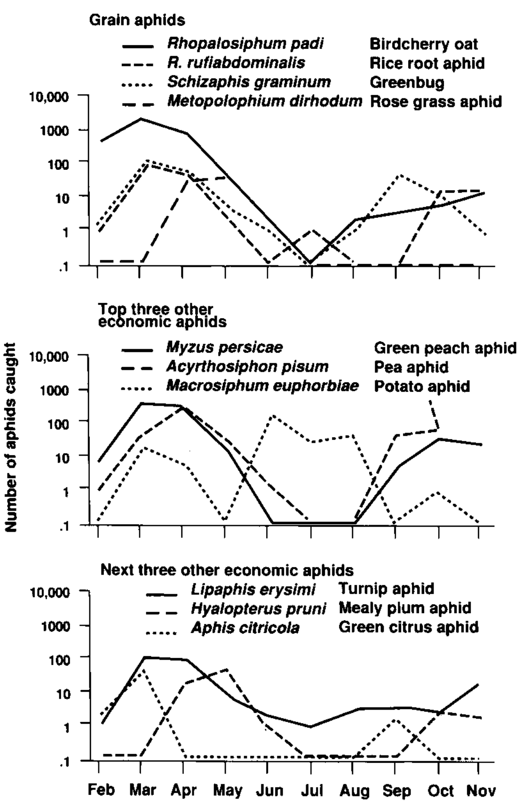

Fig. 1. Seasonal distribution of 10 aphid species caught most frequently in a suction trap at Davis, California, 1988.

birdcherry oat aphid, a common aphid pest and virus vector of worldwide distribution. In Washington state, this species is abundant during the fall, sometimes constituting up to 95% of the flying aphids, but in the warmer climate of California, its peak flights occurred between February and April. Six of the 12 species of cereal aphids trapped at Davis form colonies on the roots of wheat and other plants: western aster root aphid, dogwood aphid, *Colopha ulmicola*, apple grain aphid, rice root aphid, and elm grass root aphid). These are probably minor pests in California, except possibly rice root aphid. The remaining six species are potentially major pests, depending on their abundance and the percentage transmitting virus. Previous work by V. Burton and others in California has shown that birdcherry oat aphid, English grain aphid, rose grass aphid, and greenbug are the most important species, in that order.

The pattern or peak flight period of most economic aphid species at Davis occurred during the first half of the year in contrast to regions further north. Three exceptions were potato aphid, which peaked in June, July, and August; and pea aphid and green peach aphid, which peaked in April and also in October and November.

Green peach aphid

The presence of green peach aphid in suction trap catches in the spring or summer is important, even in low numbers, because of its potential to transmit virus to crops. Host crops include almond, cabbage, carnation, peach, pepper, potato, spinach. strawberry, sugarbeet, tomato, turnip, and wheat. Sugarbeet yellows and potato leafroll viruses are among important viruses transmitted by this aphid.

Russian wheat aphid

The Russian wheat aphid was first sighted in Mexico in 1980 and in Texas in 1986. By 1988 it was found in 15 western and midwestern states. Crop losses were estimated at about $80 million in 1988.

In California, the Russian wheat aphid was first found in Imperial County in March 1988. Its discovery in Davis by suction trap in May 1988 was significant, since the species was not previously known north of Imperial County. In addition to Imperial and Yolo counties infested in 1988, the Russian wheat aphid has been reported in 1989 in Alameda, Contra Costa, Fresno, Kern, Los Angeles, Riverside, Sacramento, San Benito, San Bernardino, San Joaquin, Santa Clara, and Solano counties. Because of this aphid's prolific nature and its high potential to damage wheat and barley, early detection and timely controls will be important during the winter and spring growing seasons.

The suction trap results indicated a very low frequency of winged Russian wheat aphids during May-July. It was not known how or if these aphids would survive through the summer in California. None were collected during the fall. However, in September-planted wheat, barley, and oats at Davis, typical symptoms of Russian wheat aphid feeding were observed in November. Specimens were positively identified later as Russian wheat aphid. This was a mixed planting of Atlas 57 barley, Tanori 71 wheat, and California Red oat varieties. In January 1989, counts were made of healthy and affected plants from three replicates of this planting. Barley was the most severely affected (71 of 134 plants, or 53%), followed by wheat with 13 of 50 plants (26%) showing symptoms induced by Russian wheat aphid. Oat was practically free of damage (2 of 182 plants, 1%).

The appearance of Russian wheat aphid in the suction trap earlier in the year was taken as a warning that this pest might appear in the next crop cycle. This was the case, since a low level of Russian wheat aphid infestation was documented at the UC Davis Agronomy Farm in November 1988. No winged individuals were found at that time on either the grain or in the trap. This result emphasizes the need for regular field scouting as well as monitoring suction traps to develop crop management information needed to reduce losses from aphids. These observations and the rapid spread of Russian wheat aphid across the western United States as well as a similarly rapid dispersion in South Africa, point to the importance of monitoring aphid distribution throughout California to develop appropriate control strategies.

Conclusions

In the first year of use in California, the suction trap provided an additional method of monitoring aphid species and their flights. The results of the first year illustrate the value of noting low frequencies of previously undetected species, such as Russian wheat aphid. Because so many California crops are affected by aphids, the expanded network of suction traps and increased ground-level scouting are highly recommended.

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