ENTOMOPHAGA 27 (1), 1982, 55-59

PREFERENCE FOR MEDIUM DENSE GRASS TUSSOCKS BY *HIPPODAMIA CONVERGENS* [*COL.* : *COCCINELLIDAE*] (1)

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The preference in the choice of hibernacula of the convergent lady beetle, *Hippodamia convergens* GUÉRIN-MENEVILLE, was investigated with regard to morphological aspects of 2 introduced range grasses, *Panicum coloratum* (L.), and *Eragrostis curvula* (SCHRAD.) Beetles strongly preferred tussocks with a ratio in the range of 1.0-3.0 stems per cm^2 for lovegrass. Preference for klein grass tussocks ranging from 110-130 stems/clump was found. No preference was shown for a particular tussock circumference. It was demonstrated that tussocks could successfully be designated as suitable for beetle aggregation.

The aggregation phenomenon, i.e. massing of individuals, is well documented among dormant coccinellids (HAGEN, 1962; HODEK, 1973). Coccinellids may aggregate depending on the locality and environmental conditions. Evidence of the assemblage behavior of *Hippodamia convergens* GUÉRIN-MENEVILLE is noted by DOUGLASS (1930) in New Mexico, GILLETTE (1923) in Colorado, HAGEN (1962) in various United States locations, SHERMAN (1938) in the Carolinas, STEWART *et al.* (1967) in Arkansas, THOMAS (1932) in North Carolinas, and THORNE (1935) in Michigan. In nearly all cases, aggregations were noted in association with mountains, or at least relatively high elevations.

Among coccinellid aggregation sites, the microhabitat varies considerably with species. Microhabitat may consist of space under a stone, rock crevices, grass clumps or tussocks, leaf litter and a variety of other objects.

Aggregations of *H. convergens* have been found to overwinter on top of Mt. Scott (elevation = 751 m) in the Witchita Mountains of southwestern Oklahoma (pers. comm. E. A. WOOD). A number of small assemblages of *H. convergens* were discovered in various grass tussocks in a lowland area west of Stillwater, OK. Within the same species of grass tussocks, certain ones were preferred for hibernationnal aggregation over others. The objective of this study was to examine morphological characteristics among preferred and non-preferred tussocks.

(1) Journal article number 3813 of the Oklahoma Agriculture Experiment Station.

MATERIALS AND METHODS

DESCRIPTION OF THE STUDY SITE. The study area is an agronomic research plot located on the Oklahoma Agricultural Experiment Station west of Stillwater, Payne County, Oklahoma. That for samples 1 and 2 consisted of 39 rows of klein grass clumps, each row approximately 25 m long. The klein grass, *Panicum coloratum* (L.), was grown from seed in a greenhouse and seedlings were transplanted individually in rows with ca. 0.5 m spacings.

The study area for sample 3 consisted of 32 rows of weeping lovegrass clumps, each row approximately 30 m long. Weeping lovegrass, *Eragrostis curvula* (SCHRAD.), possesses similar characteristics to those of klein grass (ROMMANN, 1974). It was grown from seed in a greenhouse and transplanted individually in rows with ca. 0.3 m spacing.

EXPERIMENTAL DESIGN. The 1st and 2nd samples were taken in the klein grass tussocks in Nov. 1978 and March 1979, respectively. Before any beetle counts were made, each grass clump was designated suitable or unsuitable for beetle habitation based on the symmetry of the tussock, i.e. whether stems arise in one centralized area (preferred) or stems arise in a radial manner (not preferred), and the number of stems per tussock (sparse stems not preferred). Each tussock was numbered and assigned to 1 of the 2 categories. Observations were made on 25 randomly selected tussocks of each category, replicated twice.

The 3rd sample was taken from weeping lovegrass tussocks in January 1980. Alternate tussocks in each row were sampled with one replication totaling 434 tussocks.

Parameters measured included number of coccinellids, average height of stems, number of stems per tussock and circumference of tussock at ground level. To allow for negative binomial distribution of the convergent lady beetle, beetle numbers were transformed using the procedure of KEMPTHORNE (1952).

At the outset of this experiment, it was postulated that the beetles would likely prefer tussocks of certain degrees of compactness or density. A measure of density was calculated by dividing the number of stems per tussock by its area. Duncan's Multiple Range Tests were performed for comparisons among categories.

RESULTS

All aggregations were monospecific though heterospecific aggregations have been recorded in literature (HODEK, 1973; PULLIAINEN, 1966).

Designation of tussocks to 1 of 2 categories is somewhat subjective, therefore, comparisons between categories should be made with some caution. Nevertheless, in samples 1 and 2 combined, single beetles were found in only 6 of the 50 tussocks designated as unsuitable (table 2). In addition, in sample 3, only 1 beetle was found in one of 246 tussocks designated as unsuitable (table 2).

Since the circumference was not significant for klein grass only stem number and not density ratio was used for category comparisons. Beetles preferred a range of 110-130 stems/tussock where 56 % of the total beetles were collected (table 2). Lovegrass circumference was significant at the .001 level, thus ratios were calculated and were significantly different at the .001 level. A density range of 1.0-3.0 stems/cm^2 was preferred by beetles in the lovegrass tussocks; 86 % of all the beetles collected fall into this range (table 2).

TABLE 1

Parameter means and standard errors for 2 samples of klein grass tussocks and 1 sample of lovegrass tussocks

	No. beetles	No. stems/tussock	Stem height (m)	Density (stems/cm²)
KLEIN GRASS				
Sample 1 (Nov. 1978)				
Suitable	4.3 ± 8.9b	98.1 ± 30.4c	0.7 ± 0.1	0.4 ± 0.3
Unsuitable	0.2 ± 0.4	83.2 ± 33.3	0.7 ± 0.1	0.4 ± 0.2
Sample 2 (Mar. 1979)				
Suitable	0.3 ± 0.6c	111.4 ± 59.9a	0.7 ± 0.1	0.4 ± 0.3
Unsuitable	0.1 ± 0.3	73.5 ± 32.6	0.7 ± 0.1	0.3 ± 0.1
Pooled				
Suitable	2.3 ± 6.6b	104.8 ± 47.5a	0.7 ± 0.1	0.4 ± 0.3c
Unsuitable	0.1 ± 0.3	78.5 ± 33.0	0.7 ± 0.1	0.3 ± 0.2
WEEPING LOVEGRASS				
Sample 3 (Jan. 1980)				
Suitable	2.8 ± 6.6a	375.1 ± 169.8a	0.8 ± 0.1a	1.9 ± 1.1a
Unsuitable	0.004 ± 0.1	177.8 ± 61.0	0.8 ± 0.2	1.0 ± 0.6

a) Means between suitable and unsuitable significantly different at the .01 level
b) .05 level of significance
c) .10 level of significance

TABLE 2

Distribution of dormant Hippodamia convergens *with respect to the number of stems/tussock in klein grass and stems/cm² in lovegrass.*

Density (Stems/tussock)	Sample 1 and 2 klein grass tussocks No. tussocks and beetles in interval				% of total beetles
	Suitable	Beetles	Unsuitable	Beetles	
Less than 60	5	1	15	2	2.6
61 — 70	5	21	11	1	18.9
71 — 80	5	5	5	0	4.3
81 — 90	2	1	3	0	0.9
91 — 100	6	9	4	0	7.8
101 — 110	4	0	4	2	1.7
111 — 120	9	32	2	0	27.6
121 — 130	0	33	3	0	28.4
131 — 140	2	0	3	0	0
141 — 150	3	6	1	0	5.2
151 — 160	2	0	1	0	0
greater than 160	4	2	1	1	2.6
(Stems/cm²)	Sample 3 lovegrass tussocks				
less than 1.00	42	8	153	0	2.7
1.01 — 2.0	92	208	81	0	69.3
2.01 — 3.0	39	49	12	1	16.7
3.01 — 4.0	9	34	0	0	11.3
greater than 4.0	6	0	0	0	0

DISCUSSION

The beetles prefer medium density tussocks over both the less dense tussocks and the highly dense tussocks. This preference may decrease the moisture loss during the winter. Dessication is often a primary mortality factor for overwintering beetles (McMULLEN, 1967). Further, HODSON (1937) found that both *H. convergens* and *Coleomegilla maculata* (DEGEER) showed a marked preference for certain moisture situations. Thus, the "shelter effect" in the more dense tussocks, i.e. dense protective cover and moist microenvironment, serves to both buffer temperature extremes and to maintain proper humidity, since Oklahoma winter months are often very dry.

LUFF (1965) found that height and density of grass tussocks combine to reduce temperature fluctuations within the tussocks and, similarly dense tussocks may maintain a snow layer longer than the less dense tussock. This may aid in survival since LATTA (1928) found that a temperature drop from -2° C to -12° C without snow cover resulted in 100 % mortality of *H. convergens*. Tussock selection by *H. convergens* may be influenced by the warmer temperatures of the more dense tussocks. However, in extremely high density tussocks, aggregations may be limited by the space available. This physical limitation might account for a decreased percentage of beetles found in the most dense tussocks.

In summarizing, *H. convergens* shows a preference for grass tussocks that have a moderately high density. This preference probably has an adaptive advantage that improves winter survival of the species in lowland areas. In order to increase the survival of populations of coccinellids through the winter, the preferred overwintering habitats should be preserved.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. CHARLES TALIAFERRO, Dep. of Agronomy, OSU, for the use of research plots and for the statistical consultation by Dr. WILLIAM WARDE, Dep. of Statistics. Technical assistance of JAMES NEED, LAURA HAGERSTROM, BRYAN HENDERSON, R. D. EIKENBARY, KEITH DORSCHNER and JOHN KOSTER is gratefully acknowledged.

RÉSUMÉ

Préférence de *Hippodamia convergens* [*Col. : Coccinellidae*] pour les touffes de graminées de moyenne densité

Le choix des lieux d'hivernation de la coccinelle *Hippodamia convergens* GUÉRIN-MÉNEVILLE a été étudié à l'égard des caractéristiques morphologiques de 2 graminées introduites : *Panicum coloratum* (L.) et *Eragrostis curvula* (SCHRAD.) Les insectes préfèrent de beaucoup les touffes d'agrostis ayant en moyenne 1 à 3 tiges par cm^2. Une préférence pour les touffes de panic comportant de 110 à 130 tiges par touffe a été mise en évidence. Il n'y a pas de préférence pour une forme particulière de l'extérieur de la touffe. Avec ces données on peut désigner avec succès les touffes favorables au rassemblement des coccinelles.

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