Caspian J. Env. Sci. 2008, Vol. 6 No.1 pp. 47~51

CJES
Caspian Journal of Environmental Sciences

[Research]

Abundance of adult hoverflies (Diptera: Syrphidae) on different flowering plants

H. Sadeghi

Dept. of Plant Protection, College of Agriculture, Ferdowsi University of Mashhad,Iran.
E-mail: husseinsadeghi@yahoo.co.uk

ABSTRACT

Encouraging natural enemies by growing attractive plants is considered an effective method of pest control in organic farming. However, it is important to identify which flowers best attract beneficial insects. In this study, relative attractiveness of 16 species of flowering plants to adult hoverflies was assessed by conducting timed observations of feeding-visit frequencies. The experiments were conducted at two sites, at FUM Research Farm and FUM Campus in a completely randomized design with 3 replications. At both sites, there were significant differences between the mean numbers of feeding-visits to selected flowers by hoverflies. At the Research Farm Fennel, Chamomile, Hypericum, Yarrow, Lavender and Bishop's weed had higher visit rates than Marigold, Spider ivy, Sage, Dill and Dwarf Lark Spur. At this site, Fennel followed by Hypericum and Yarrow attracted more hoverflies than other flowers throughout the season. Lavender and Bishop's weed that were less attractive on early sampling dates received more hoverflies toward the end of the season. At the FUM Campus, Petunia, Chamomile and Cosmos were the most attractive flowers, whereas Ageratum, Yarrow and Coreopsis were of intermediate visit status and Pot marigold was relatively under visited. On the whole, Cosmos, Petunia and Chamomile were visited more frequently than other floral sources, but their attractiveness were not constant throughout the season. On the first two sampling dates, Chamomile was the most preferred flower, but on the last two dates of sampling Cosmos was highly attractive to hoverflies. The hoverflies found in the study sites were: *Sphaerophoria scripta* (L.), *Episyrphus balteatus* (DeGeer), *Eupeodes corollae* (Fab.), *Syrphus ribesii* (L.), *Eupeodes nuba* (Wied.), *Syrphus vitripennis* (Meigen), *Paragus bicolor* (Fabr.), *Sphaerophoria ruppellii* (Wied.), *Paragus tibialis* (Fallen), *Eristalis* spp., *Syritta pipiens*. *Sphaerophoria scripta, Episyrphus balteatus* and *Eupeodes corollae* , which were the most abundant aphidophagous species.

Keywords: Pollen and nectar resources, Enhancing biological control, Flower flies.

INTRODUCTION

A range of hoverfly species occur in agroecosystems. Many larvae of them are aphidophagous and shown to be economically important (Chambers *et al*., 1985). Some studies have shown that they have the potential to halt aphid population growth (Chambers & Adams 1986; Luna & Colley 2000). The adult hoverflies feed mainly on nectar and pollen of flowering plants. Flowers are vital sources of amino acids and carbohydrates, which the adult hoverflies require for egg production and energy (Gilbert 1993; Stubbs & Falk 1996). These floral resources are also important for the growth, development, survival and reproduction and therefore the efficiency of many other natural enemies, including Chrysopidae, Coccinellidae, several parasitoid wasp families and Tachinidae depends on availability of preferred floral resources (Jervis *et al*., 1993; Landis *et al*., 2000). In agroecosystems, some insects may depend on weeds for pollen and nectar (Marshal *et al*., 2003). Unfortunately in recent years, agricultural practices such as herbicide use have reduced floral diversity which may limit the potential role of some natural enemies in biological control of insect pests. So, introducing flowering plants into

agroecosystems would be one of the best ways to increase pollen and nectar sources that stimulate populations of the insect pests' natural enemies (White *et al*., 1995; Verkerk 2001). Several studies have shown the potential of establishing selected flowering plants in or around fields to attract hoverfly adults resulting in increased oviposition rates within fields and thus decrease in aphid population numbers (e.g., Kloen & Altieri 1990, Lovei *et al*., 1993, White *et al*., 1995, Hickman & Wratten 1996; Colley & Luna 2000, Ambrosino *et al*., 2006).

In Iran, little information is known about the potential of aphidophagous hoverflies in biological control and also, about the ways of enhancing their activities. While candidate plant species under consideration for the augmentation of floral sources should ultimately be screened for a wide range of attributes including their agronomic and economic compatibilities with the cropping systems, their relative attractiveness to key natural enemies is an important initial consideration. The aims of the present work were to identify the most preferred floral sources by hoverflies as well as aphidophagous hoverflies fauna present in the agricultural systems in the region.

MATERIALS AND METHODS

Two field studies were conducted in 2006, one at Ferdowsi University of Mashhad (FUM) Farm Research, (36° 14′ N & 59° 40′ E) where there is an organic garden of 2 hectars with 120 medicinal and ornamental plant species and the other at FUM campus, an area of about 360 ha. with a variety of ornamental flowers. Hoverfly observations were made on 11 and 8 flowering plants at FUM Farm Research and FUM Campus respectively. In both cases, survey was done in a complete randomized-block design with 3 replications.

Preferences of flowering plants by foraging hoverflies was assessed by observing the frequency of feeding visits to plots of the flowers of 1 square meter per 5 min. Hoverflies entering the plot and feeding from flowers were counted as feeding visits. Survey was carried out from 5 July to 21 August at the FUM Farm Research and 9 July to 14 August at FUM Campus.

A sweep net was used to collect representatives of hoverflies associated with sampled flowers. Then, these specimens identified by comparing them with the reference specimens collected during previous studies (Sadeghi 2002; Sadeghi *et al*., 2005; Shtakelberg 1988).

Differences in the feeding frequencies of adult hoverflies visiting flowering plants were assessed by conducting analysis of variance (ANOVA) procedures and mean separation test. ANOVA was done using MSTAT-C software. A least significant difference multiple range test was used for comparing feeding frequency means. An alpha level of 0.05 was used as a rejection criterion for hypothesis testing.

RESULTS

At the FUM Farm, the mean numbers of the feeding-visits to the selected flowers by hoverflies differed significantly ($P<0.01$). Fennel, Chamomile, Hypericum, Yarrow, Lavender and Bishop' weeds had higher visitation rates than Marigold, Spider ivy, Sage, Dill and Dwarf Lark Spur (Fig 1). At this site, Fennel followed by St. John's Wort and Yarrow attracted more hoverflies than other flowers throughout the season. Chamomile, Lavender and Bishop' weeds that were less attractive on early sampling dates received more hoverflies toward the end of the season (Table 1).

At the FUM Campus, there were clear differences between flowers in terms of feeding-visit frequencies of adult hoverflies ($P< 0.01$). Petunia, Chamomile and Cosmos were the most attractive flowers whereas Ageratum, Yarrow and Coreopsis were of intermediate visit status and Pot marigold was relatively under visited (Fig 2). Overaly, Cosmos, Petunia and Chamomile were visited more frequently than other floral sources, but their attractiveness were not constant throughout the season. On the first two sampling dates, Chamomile was the most preferred flower, but on the last two dates of sampling Cosmos was highly attractive to hoverflies (Table 2). At this site, no hoverflies was observed feeding on *Portulaca* sp.

The hoverflies species including *Sphaerophoria scripta* (L.), *Episyrphus balteatus* (DeGeer), *Eupeodes corollae* (Fab.), *Syrphus ribesii* (L.), *Eupeodes nuba* (Wied.), *Syrphus vitripennis* (Meigen), *Paragus bicolor* (Fabr.), *Sphaerophoria ruppellii* (Wied.), *Paragus tibialis*

(Fallen), *Eristalis* spp. and *Syritta pipiens* were found in the current study. Among the aphidophagous species, the most abundant species were *Sphaerophoria scripta, Episyrphus balteatus* and *Eupeodes corollae*. In both sites, *Eristalis* spp. and *Syritta pipiens* were the the most common non- predatory hoverflies species that visited test flowers.

It is difficult to compare the relative preferences exhibited by hoverfly species at two sites with each other because of differences in hoverfly and /or plant species, environmental context and the interaction that these factors can have with each other. For the same reasons, the other studies of relative preference are less comparable to the present study.

Although the relative attractiveness of floral sources to key natural enemies and phytophagous species is an important initial consideration, the candidate plant species for the augmentation of floral sources should ultimately be screened for a wide range of atributes including their agronomic and economic compatibility with the crop plants as well as the relative impact that each flower species may have on the fecundity and longevity of beneficial insects.

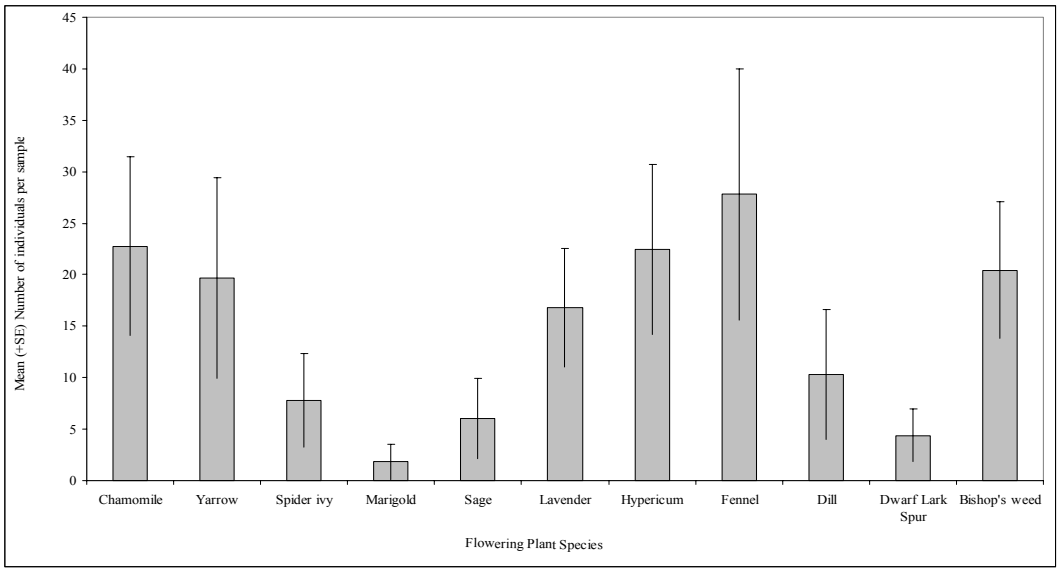

Fig 1. Observed Mean number of hoverflies (±SE) visited the 11 flower treatments over sampling dates at FUM Farm, 2006.

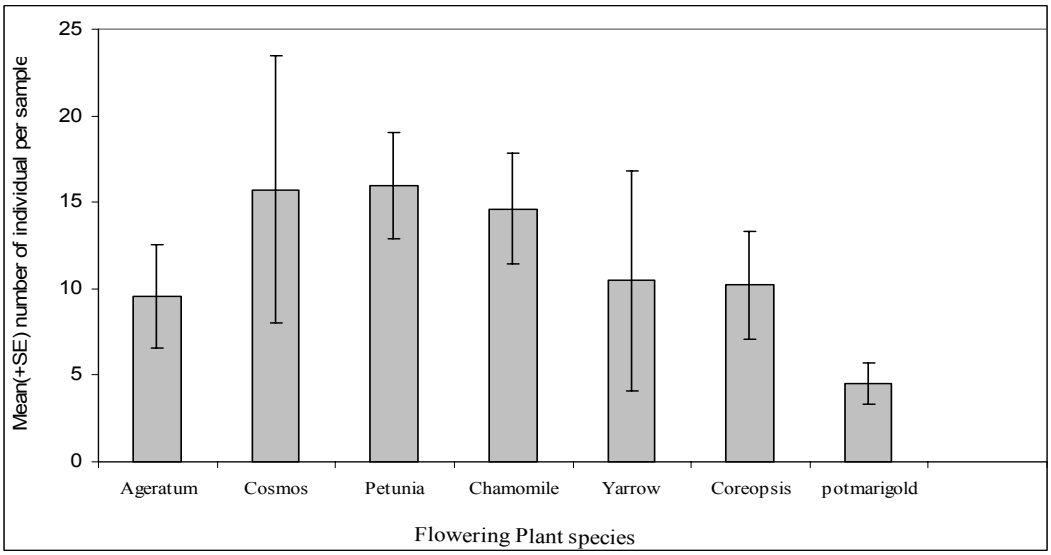

Fig 2. Observed Mean number of hoverflies (±SE) visited the 7 flower treatments over sampling dates at FUM Campus, 2006.

Table1. Observed Mean (±Se) number of hoverflies visited selected flowers over sampling dates at Research Farm of the Agricultural College of Ferdowsi University of Mashhad, Iran, 2006.

Flower species	5 Jul	13 Jul	23 Jul	31 Jul	5 Aug	12 Aug	21 Aug
Chamomile(*Matricaria chamomile*, Asteraceae)	33.3±3.5bc	32.3±6.03b	25.7±7.5ab	21.3±4.5ab	18.3±3.05ab	16.7±2.5ab	11.7±4.5a
Yarrow(*Achillea millefolium*, Asteraceae)	25.7±3.5b	29±4.5b	20.3±1bc	16±5bc	14±1.5b	14.3±5.3bc	8.3±6.1abc
Fennel (*Foeniculum vulgare, Apiaceae*)	43±4.04a	44.7±8a	29±5.7a	24.3±3.1a	20.3±3.6a	20±4.04a	13.3±7.5a
Marigold (C*alendula officinalis*, Asteraceae)	3.7±0.57h	3±1.1g	2.3±1f	1.7±2.8c	1±0.57c	0.7±1e	0.3±2.1d
Lavender (*Lavendula officinalis*, Labiateae)	23.7±2.5de	23.3±1.5c	20±4c	15±2c	14±1b	12.3±2.9cd	9.3±3.5ab
Dill (*Anethum graveolens*, Apiaceae)	19.7±2.5e	17.3±1d	12±1.53d	9±2d	6.3±2c	5±2.5de	2.7±2.8d
Spider ivy(*Chlorophytum comosum*, Liliaceae)	13.7±2.5f	13±3.5de	9.7±1d	5±2de	5±2.8c	3.7±1.7e	4.3±3.5bcd
Sage (*Salvia officinalis*, Labiateae)	10.3±2fg	11±1ef	8±2de	3.7±3.5	4±1c	2±1e	3±2.5cd
Hypericum (*Hypericum perfuratum*, Hypericaceae)	32.7±3a	30±2b	28±5.5a	19.7±2.5abc	20.7±2a	16±4.4ab	10±3.2a
Dwarf Lake spur (*Delphinium* sp., Ranunculaceae)	8±2.5gh	5.7±2fg	4±2ef	4±2ef	2±1c	3±2.1e	4±3.6bcd
Bishop's weed(*Trachysperum copticum*, Apiaceae)	28.3±2cd	27.3±1.53bc	24±7abc	18.7±1.5bc	18±1ab	14.7±3.1bc	12±4.2a

Each sample is mean no. of individuals/ 5 min/m^2). Means with different letters within columns are significantly different at alpha level.

Table 2. Observed Mean (±Se) number of hoverflies visited selected flowers over sampling dates at Campus of Ferdowsi University of Mashhad, Iran, 2006.

Flower species	9 Jul	17 Jul	26 Jul	5 Aug	14 Aug
Chamomile (*Matricaria chamomile*, Asteraceae)	19±1a	15±1ab	14±2ab	14±3c	11±2.6bc
Yarrow (*Achillea millefolium*, Asteraceae)	16.67±3.05ab	17±1a	11±3.6bc	4.3±2.5e	3.33±0.57ef
Petunia (*Petunia juss*, Solanaceae)	15.33±5.5bc	17±2a	15.67±1.53a	18.33±2.51b	13.33±1.52b
Pot marigold (*Tagete erecta, Asteraceae)*	4.67±1.53f	5±1e	4.33±0.53d	5±2e	3.67±0.57e
Ageratum(*Ageratum houstonianum*,Asteraceae)	10.67±4.5de	12.32± 0.58bc	9±1c	9.67±2.5d	6± 1de
Cosmos(*Cosmos bipinnatus,Compositae*)	12 ± 2cd	7± 1de	12 ±2bc	27.33±2.52a	20.33±3.51a
Coreopsis (*Coreopsis* sp., Compositae)	7.33±3.5 de	9±1 cd	12.3±2.5 abc	14±1 c	8.33±1.5 cd

Each sample is mean no. of individuals/ 5 min/m^2). Means with different letters within column are significantly different at alpha level.

ACKNOWLEDGMENTS

The author would like to thank Dr Nasiri Mahallati for his statistical assistance. Also, thank to those students helped with field sampling. This study financially supported by the College of agriculture, Ferdowsi University of Mashhad who is gratefully thanked.

REFERENCES

Ambrosino, M.D., Luna, J.M., Jepson, P.C. & Wratten, S.D. (2006) Relative frequencies of visits to selected insectary Plants by Predatory Hoverflies (Diptera: Syrphidae), Other Beneficial Insects and Herbivors. *J. Environ. Entomol.* **35(2),** 394-400.

Chambers, R.J., Sunderland, K.D., Stacey, D.L. & Wyatt, I.J. (1985) Control of Cereal aphids in winter wheat by natural enemies: aphid-specific predators, parasitoids and pathogenic fungi. *Annals of Applied Biology*, **108,** 219-231.

Chambers, R.J. & Adams, T.H.L. (1986) Quantification of the impact of hoverflies (Diptera: Syrphidae) on cereal aphids in winter wheat: an analysis of field populations. *Journal of Applied Ecology,* **23,** 895-904.

Colley, M.R. & Luna, J.M. (2000) The relative attractiveness of potential beneficial insectary plants to aphidophagous hover flies (Diptera: Syrphidae). *Environ. Entomol.* **29,** 1054-1059.

Gilbert, F.S. (1993) *Hover flies*. Naturalist's Handbook No.5. Richmond Pub. Sloughs England.

Hickman,J. & Wratten, S.D. (1996) Use of *Phacelia tanacetifolia* strips to enhance biological control of aphids by hoverfly larvae in cereal fields. *J. Econ. Entomol.* **89,** 832-840.

Jervis, M.A., Kidd, N.A.C., Fitton, M.G., Huddleston, T. & Dawah, H.A. (1993) Flower visiting by hymenopteran parasitoids. *J. Nat. Hist.* **27,** 67-106.

Kloen, H. & Altieri, M. (1990) Effect of mustard (Brassica hirta) as a non- Crop plant on competition and insect pests in broccoli. *Crop Protection,* **9,** 90-96.

Landis,D.A., Wratten, S.D., Gurr, G.M. (2000) Habitat management to conserve natural enemies of arthropod pests in agriculture. Ann. Rev. *Entomol.* **45,** 175-201.

Lovei, G.L., Hodgeson, D.J., Macloed, A. & Wratten, S.D. (1993) Attractiveness of some novel crops for flower-visiting hoverflies (Diptera: Syrphidae0: comparisons from two continents. pp. 368-370. In: S.Corey (ed.) Pest control and sustainable agriculture.CSIRO,Canberra, Australia.

Luna, J. Colley, M.R. (2000) Enhancement of biological control with beneficial insectary plantings. Organic Farming Foundation Project Report No. 98-27, 15 pp.

Marshall E.J. P., Brown, V.K. Boatman, N.D, Lutman, P.J.W., Square, G.R.& Ward, L.K. (2003) The role of weeds in supporting biological diversity within crop fields. *European Weed Research Society, Weed Research*, **43,** 77-89.

Sadeghi, H. (2002) Part of Syrphid fauna of Mashhad region and key to the genera. *J. of Agricultural Sciences and Natural Resources,* Gorgan University, Vol. **9(1),** 119-127.

Sadeghi, H., Husseini, A. and Mohammad Abadi, A.A. 2005. The effect of application of 2-4.D & Benoron methyl herbicides on insects: Aphids and aphidophagous syrphid species . *J. of Agricultural Sciences and Technology,* Ferdowsi university of Mashhad, Vol. **20(3),** 101-109.

Shtakelberg,A.A. (1988). Family Syrphidae. In: G.Ya. Bei-Bienko (ed.). Keys to the Insects of the European part of the USSR. Vol.V (part II). Smithsonian institution Libraries and The national Science Foundation, Washington D.C.

Stubbs, A.E. & Falk, S.J. (1996) British Hoverflies: an illustrated Identification Guide.British Museum of Natural History, London.

Verkerk, R. (2001) Farmers'friends. Recognition and conservation of natural enemies of vegetable pests. Biology Department, Imperial College, Journal of Science, Technology and Medicine, London.

White, A.J., Wratten, S.D., Berry, N. A. & Weigmann, U. (1995) Habitat manipulation to enhance biological control of brassica pests by hover flies (Diptera: Syrphidae). *J. Econ. Entomol.* **88,** 1171-1176.