EVALUATION OF FLOWERING PLANTS TO ATTRACT NATURAL ENEMIES IN TAJIKISTAN

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Abstract

This article outlines the results of evaluation attractiveness of 12 species flowering plants to entomofauna in Tajikistan. The specific objective of our study was to screen plants common in Central Asia to determine their attractiveness to insect natural enemies and herbivorous insects. The selected plants formed a continuum of bloom from June-October. For analysis we divided the species into two groups based on their bloom period: mid season Coriandrum sativum L., Anethum graveolens L., Ziziphora interrupta Juz., Ocimum basilicum L., Calendula officinalis L. Helianthus annuus L. and late season: Zinnia elegans Jacq., Celosia cristata L., Celosia argentea L., Impatiens balsamina L., Tagetes erecta L. and Foeniculum vulgare Mill. Among the plants in our study, we found marked differences in their attractiveness to natural enemies and herbivores, both season-long and during their maximum bloom periods. Of the in mid season blooming plants, C. sativum, A. graveolens show the most promise for use in habitat management. Of the late season blooming plants, F. vulgare, I. balsamina show the most promise. In contrast, C. cristata, and C. argentea which attracted larger numbers of herbivores may have a role as trap crop plants for attracting pests. Future research should test a subset of these plants to determine their impact on pest management in agricultural landscapes.

Introduction

The conservation of natural enemies in agroecosystems depend on series of factors such as anthropogenic, soil and weather conditions, landscape diversity and presence of food source such as plant nectar. Landscape diversity can be increased by preserving, restoring or creating plant communities that provide needed resources to natural enemies. In the intensively farmed landscapes of Central Asia the latter is likely required while in parts of the region preservation or restoration may be appropriate. Under the funding from the USAID IPM CRSP, this project is looking at increasing the diversity of plant communities through habitat management to increase biological control of pests. The objective of this research is to investigate the use of native plants for conserving natural enemy communities and enhancing biological control of field crop pests in Central Asia. Flowering plants were evaluated for their attractiveness to natural enemies of pests in Tajikistan.

The composition and nature of vegetation around agricultural crops can provide natural enemies with additional food sources such as plant nectar. For example, the egg-parasites *Microphanurus vassilievi* Mayr., and *M semistriatus* Nees, which attack sun-pest, benefit from the presence of various Apiaceae (Umbelliferae) around the field (Rubtsov 1948). It has also been shown that the bark of mulberry, apricot, and other trees form ridges where beneficial insects congregate for overwintering (Rubtsov 1948). Finally, the wildflowers *Ferula assa-foetida, F. badrakema, Senecio subdentatus, Lepidium draba and Anethum graveolens* are know to attract parasitic Braconidae wasps in natural landscapes of Tajikistan and Turkmenistan (Tobias, Saidov 1992 and Saidov 2000).

The use of plants to attract beneficial insects and enhance their effectiveness is a form of conservation biological control referred to as habitat management (Landis et. al. 2000). Given the current changes in agriculture in Tajikistan, we were interested in exploring habitat management as a potential means of reducing reliance on pesticides. Ecologically based Integrated Pest

Management (IPM) seeks to maximize the suppression of insect, weed and disease pests by enhancing the effectiveness of their natural enemies. The specific objective of our study was to screen plants common in Central Asia to determine their attractiveness to insect natural enemies and herbivorous insects.

Methods

In 2006 we established research plots to test the attractiveness of 12 known and potential resources plants currently available in Tajikistan (Table 1). Plants such as *C. sativum, A. graveolens, O. basilicum and F. vulgare* were selected because they were previously studied for this purpose in Russia, Moldova and Ukraine (Adashkevich, 1971, 1974, Chumakova 1971, Vorotynseva, 1975). We also included additional plants such as *Z. interrupta, I. balsamina, H. annuus, C. cristata and C. argentea* which are commonly distributed in Central Asia. The experiment was conducted in a continuous single block design with one replicate of each plant species in a block. Plants were established in 2 m^2 plots spaced 0,5 m apart with between plots but except of two plants *Ocimum basilicum* L. and *Helianthus annuus* L. which were planted in narrow 0,5 m strip 20 m in length and parallel with both side blocks separately. From June through October 2006, arthropods were sampled weekly from flowering plants between the hours of 8.00-12.00 on windless, sunny days. Insects were collected with a standard entomological sweep net by taking five sweep samples from each plant block. Insects were separated into natural enemies, herbivores, other and were identified to family, and counted. Insects from any parasitic or predaceous family, or genus or species within a family known to be parasitic or predaceous, were included as natural enemies. Insects were counted as herbivores if they were a member of a family known to be broadly herbivorous. Attractiveness here is based on the number of natural enemy arthropods collected per sample; therefore, it includes both arthropod attraction to the plant and subsequent retention on it. Voucher specimens have been deposited in the Institute of Zoology and Parasitology of Academy of Science of Tajikistan.

Table 1. Flowering phenology of potential resource plants in Tajikistan, 2006. Plants are listed in order of bloom. ■=peak bloom date, ▪=full bloom, –=in bloom.

	Month	June			July					August					September					October				
	Weeks*	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Mid season	*Coriandrum sativum L.*	–	–	▪	▪	■	■	▪	▪	–	–													
	Anethum graveolens L.	–	–	▪	▪	■	■	■	▪	–	–													
	Ziziphora interrupta Juz.	–	–	▪	■	■	■	▪	–	–														
	Ocimum basilicum L.	–	–	–	▪	■	■	■	■	▪	▪	–	–											
	Calendula officinalis L.		–	–	▪	■	■	■	■	▪	–	–	–											
	Helianthus annuus L.			–	–	▪	■	■	▪	▪	–													
Late season	*Zinnia elegans Jacq.*						–	–	▪	▪	■	■	■	■	▪	▪	▪	–	–					
	Celosia cristata L.								–	–	▪	■	■	■	■	▪	▪	–	–					
	Celosia argentea L.									–	▪	■	■	■	■	▪	▪	–	–					
	Impatiens balsamina L.									–	–	▪	▪	■	■	■	▪	–	–					
	Tagetes erecta L.												–	–	▪	▪	■	■	■	■	▪	▪	–	–
	Foeniculum vulgare Mill.												–	–	–	–	–	▪	■	■	■	▪	–	–

*weeks refer to days of month: week 1 =days 1-7; week 2 = days 8-14 etc.

Results

The selected plants formed a continuum of bloom from June-October (Table1). For analysis we divided the species into two groups based on their bloom period: mid season (15 June through 25 August) and late season (15 July through 31 October). *C. sativum, A. graveolens, Z. interrupta, O. basilicum, C. officinalis and H. annuus* bloomed during the mid season period, while *Z. elagans, C. cristata, C. argentea, I. balsamina, T. erecta and F. vulgare* bloomed during the late season. The number of natural enemies collected at all flowering plants by order and family is summarized in Table 2. The most numerous taxa was Hymenoptera comprising 41.3% of total with the most numerous families including; Chalcidoidea 9%, Sphecidae 7.7%, Braconidae 7.7%, Ichneumonidae 7%, and Aphidiidae 5%. Diptera were the next most abundant order representing 20.1% of the total and were comprised of Syrphidae 14.3% and Tachinidae 5.7%. Heteroptera comprised 13.5% of the total with Anthocoridae 11.2% as the most abundant family. Coleoptera represented 11.1% of the total Coccinellidae 9.4% as the most numerous family. Arachnida 6.7% and Neuroptera 6.1% were represented by individual familes. Finally, Odonata 0.7% and Mantoptera 0.4% made up the

Table 2. Number of natural enemies collected at flowering plants by order and family in Tajikistan, 2006.

ORDER		**Coleoptera**		**Heteroptera**		**Diptera**		**Hymenoptera**							**Neuroptera**	**Odonata**	**Mantoptera**	**Arachnida**	**Total**	**Mean per sample**
Plant species*	Number of samples	Coccinellidae	Carabidae	Anthocoridae	Nabidae	Syrphidae	Tachinidae	Braconidae	Aphidiidae	Chalcidoidea	Cynipoidea	Ichneumonida	Sphecidae	Vespidae	Chrysopidae	Odonata	Mantidae	Spider		
C. sativum	10	31	4	16	8	16	8	20	17	12	6	16	14	4	16	0	0	14	**202**	**20.2**
A. graveolens	9	23	3	21	7	27	5	14	15	13	5	15	7	5	21	0	1	17	**199**	**22.1**
Z. interrupta	9	20	5	33	13	23	14	16	15	21	4	22	23	6	7	2	0	11	**235**	**26.1**
O. basilicum	12	23	12	35	11	26	19	18	7	19	7	20	16	9	17	2	0	12	**253**	**21.1**
C. officinalis	10	24	5	13	5	19	8	17	8	11	2	14	13	4	16	0	2	15	**176**	**17.6**
H. annuus	8	10	0	7	1	5	0	0	0	0	0	0	10	6	14	1	4	5	**63**	**7.8**
Z. elegans	13	13	2	22	3	31	15	8	2	7	6	13	7	9	12	4	3	13	**170**	**13.1**
C. cristata	12	20	0	12	2	19	2	9	4	24	0	6	15	6	2	3	0	17	**141**	**11.8**
C. argentea	11	17	0	11	0	20	10	7	0	15	0	5	14	4	5	1	0	15	**124**	**11.3**
I. balsamina	10	8	0	13	0	19	8	20	10	40	2	17	16	6	6	0	0	8	**173**	**17.3**
T. erecta	12	10	5	50	3	66	23	24	16	14	8	20	22	12	11	1	0	15	**300**	**25.0**
F. vulgare	12	19	2	26	0	59	21	18	20	32	6	14	20	6	15	2	0	13	**273**	**22.8**
Total	**128**	**218**	**38**	**259**	**53**	**330**	**133**	**171**	**114**	**208**	**46**	**162**	**177**	**77**	**142**	**16**	**10**	**155**	**2309**	**18.0**
% of total		9.4	1.6	11.2	2.3	14.3	5.7	7.4	5	9	2	7	7.7	3.3	6.1	0.7	0.4	6.7	**100**	

* listed in order of bloom period from top to bottom

Table 3. Number of herbivores collected at flowering plants by family in Tajikistan, 2006.

ORDER		**Coleoptera**		**Heteroptera**					**Diptera**			**Homoptera**		**Ortoptera**	**Thysanoptera**	**Lepidoptera**	**Total**	**Mean per sample**
Plant species*	Number of samples	Chrysomelidae	Curculionidae	Coreidae	Miridae	Lygaeidae	Pentatomidae	Pyrhocoridae	Agromyzidae	Tephritidae	Tipulidae	Cicadellidae	Aphidinea	Ortoptera	Thysanoptera	Lepidoptera		
C. sativum	10	5	5	11	9	5	5	2	20	4	5	10	18	0	7	9	**115**	**11.5**
A. graveolens	9	2	4	8	14	4	7	4	12	3	4	4	12	0	8	7	**93**	**10.3**
Z. interrupta	9	0	8	93	12	6	5	0	6	6	2	3	20	4	0	8	**173**	**19.2**
O. basilicum	12	6	10	20	4	10	4	6	44	2	3	14	9	3	0	11	**146**	**12.2**
C. officinalis	10	6	7	8	8	3	3	1	11	8	6	13	17	0	10	10	**111**	**11.1**
H. annuus	8	0	0	4	7	1	4	0	0	0	0	8	0	5	0	0	**29**	**3.6**
Z. elegans	13	3	9	6	4	7	2	3	12	0	0	36	0	0	0	11	**93**	**7.2**
C. cristata	12	0	1	1	7	5	2	2	111	9	2	73	18	0	2	9	**242**	**20.2**
C. argentea	11	0	4	5	3	3	1	6	81	5	4	38	14	1	0	8	**173**	**15.7**
I. balsamina	10	0	5	4	1	0	0	1	58	0	1	10	5	0	0	6	**91**	**9.1**
T. erecta	12	0	4	5	4	3	5	5	125	12	7	134	0	1	0	24	**329**	**27.4**
F. vulgare	12	0	5	0	3	0	4	3	98	7	10	36	8	0	0	11	**185**	**15.4**
Total	**128**	**22**	**62**	**165**	**76**	**47**	**42**	**33**	**578**	**56**	**44**	**379**	**121**	**14**	**27**	**114**	**1780**	**13.9**
% of total		1.2	3.5	9.3	4.3	2.6	2.3	1.9	32.5	3.1	2.5	21.3	6.8	0.8	1.5	6.4	**100**	

* listed in order of bloom period from top to bottom

remainder of the natural enemy captures. Across all plant species, Syrphidae 14.3%, Anthocoridae 11.2% and Coccinellidae 9.4% were the most abundant natural enemy families attracted. Over the entire flowering season; *T. erecta, F. vulgare, O. basilicum and Z. interrupta*, attracted the most total natural enemies. However, when divided by the total number of weeks in bloom, *Z. interrupta* was the most attractive followed by *T. erecta, F. vulgare and A. graveolens. O. basilicum, C. sativum and C. officianlais, and I. balsamina* also have high rates of attractiveness (Table 3). The number of herbivores collected at all flowering plants by order and family is summarized in Table 3. The most numerous taxa by order were Diptera representing 38.1% of total number with most numerous family Agromyzidae 32.5%. Homoptera were the next most abundant comprising 28.1% of the total with the most numerous family being the Aphididae 6.8%. Heteroptera comprised 20.4% of the total with Coreidae 9.3% the most numerous family. Herbivores Coleoptera, Ortoptera, Thysanoptera and Lepidoptera comprised less than 10% of total of collected insects. Over the entire flowering season *T. erecta* and *C. cristata* attracted more herbivores in total and in average number per sample than other plants.

Conclusions

Among the plants in our study, we found marked differences in their attractiveness to natural enemies and herbivores, both season-long and during their maximum bloom periods. Of the in mid season blooming plants, *C. sativum, A. graveolens* show the most promise for use in habitat management in Tajikistan, followed by *Z. interrupta, C. officinalis and O. basilica.* Of the late season blooming plants, *F. vulgare, I. balsamina* show the most promise. In contrast, *C. cristata,* and *C. argentea* which attracted larger numbers of herbivores may have a role as trap crop plants for attracting pests. Future research should test a subset of these plants to determine their impact on pest management in agricultural landscapes.

ОЦЕНКА ПРИВЛЕКАТЕЛЬНОСТИ ЦВЕТКОВЫХ РАСТЕНИЙ ЭНТОМОФАГОВ В УСЛОВИЯХ ТАДЖИКИСТАНА

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Ключевые слова: сохранение энтомофагов в природе, управление среды местообитания, нектароносные растение, природные враги вредителей сельскохозяйственных культур

Резюме

В статье приводятся результаты исследований по оценке привлекательности у 12 видов цветковых растений к энтомофауне в Таджикистане. Особой целью работы явилось изучение видов растений, распространенных в Центральной Азии и определение их свойства привлекательности, как энтомофагов, так и фитофагов. Выбранные растения на опытном участке формировали, непрерывное цветение, начиная с июня по октябрь месяцы. Для анализа цветковые растения в зависимости от периода их цветения были разделены на две группы: среднее цветущие Coriandrum sativum L., Anethum graveolens L., Ziziphora interrupta Juz., Ocimum basilicum L., Calendula officinalis L. Helianthus annuus L. и поздне цветущие: Zinnia elegans Jacq., Celosia cristata L., Celosia argentea L., Impatiens balsamina L., Tagetes erecta L. и Foeniculum vulgare Mill. Результаты исследований показали, что среди растений отмечены явные различия в их привлекательности энтомофауны, как в течение вегетационного развития, так и в периоды их максимальных цветения. Из первой группы C. sativum и A. graveolens а из второй F. vulgare и I. balsamina оказались наиболее перспективными нектароносными растениями для использования их в управлении среды местообитания живых организмов. В отличие от них виды C. cristata и C. argentea привлекали большое число

растительноядных насекомых, которые могут играть роль как растения-ловушки. Дальнейшие наши исследования должны определить их влияние на управление вредителей в сельскохозяйственных ландшафтах.

Literature

Adashkevich B.P. 1971. The role of nectariferous in attraction aphids natural enemies to pea fields. In the annual "Biological methods of protection fruit and vegetable crops from insect pest, diseases and weed as bases of the integrated systems". The thesis's report, October 1971, Kishinev, p. 4-6.

Adashkevich B.P. 1974. Number Dynamic of Predatory Insects on Nectariferous Plants. In the bulletin of research information. Kishinev, Publishing house Central Committee of Communistic Party of Moldavia, p. 11-18.

Chumakova B.M. 1971. The role of the additional feeding in increasing of efficiency parasitic hymenopteran's in the agro biocenosis. In the annual "Biological methods of protection fruit and vegetable cultures from pest, diseases and weed as bases of the integrated systems". The thesis's report, October 1971, Kishinev, p. 111-113.

Landis, D.A., S.D. Wratten, & G.M. Gurr, 2000. Habitat management to conserve natural enemies of arthropod pests in agriculture. Annual Review of Entomology 45: 175-201.

Rubtsov I.A., 1948. Biological method of control with insect pests. OGIZ Selikhozgiz, State publishers of the agricultural literature, Moscow, Leningrad, 412 p.

Saidov N.SH. 2000. The fauna of Braconid wasps (Hymenoptera, Braconidae) in alfalfa biocenosis in the south of Tajikistan. In the annual "Second conference young scientist of Tajikistan". Dushanbe, p. 169-171.

Tobias V.I., Saidov N.Sh. 1992. Effect of wind on daily activity of parasitic Hymenopterous insects (with Braconid wasps as an example) (Hymenoptera Parasitica, Braconidae). Entomology review, volume 72, issued 2, p. 339-347.

Vorotynseva A.F. 1975. The influence nectariferous on contamination parasite to codling moth and apple-leaf moths. In the annual "Protection of the plants from pest and diseases". Publishing house "Cartiya Moldovenyaske", p. 43-46.