Non syndromic pollination of *Cyclamen persicum* in Israel

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Abstract

Pollination of *Cyclamen persicum* is entirely dependent on insects since self-pollination is prevented by a mechanism of self-incompatibility and there is no wind pollination. *C. persicum* floral structure matches a typical buzz-pollination syndrome by large bees, which is very rarely found under natural conditions. The secondary pollinators were found to be several unspecialized species of Thysanoptera and Syrphidae while the main pollinator was a primitive moth *Micropterix berytella* (Lepidoptera, Micropterigidae). This tiny moth (4 mm) feeds on *C. persicum* pollen using its chewing mandibles, mates on the flower, lays eggs on the corolla, and takes shelter inside the flower from rain and on cold nights.

Introduction

The pendulous flowers of *Cyclamen* suggests buzz-pollination by large bees (Picture 1), as was recently found in *C. repandum*, and *C. hederifolium* . Accordingly, we expected to find the same syndrome in *C. persicum.* Preliminary observations showed that *C. persicum* was visited by various agents such as: small moths, thrips, and very rarely by bees and syrphids. This study evaluated the relative contribution of the flower's visitors to the pollination success of the *C. persicum.*

Picture 1.
Flowers of *C. persicum* — The corolla "mouth" surrounded by a deep pink colored ring that emphasizes the entrance to the reproductive organs.

Study site

The research was conducted at Ramat-Hanadiv, southern Mt. Carmel in Israel. Synanthous plants (flowering and leafing are simultaneous) of *C. persicum* are very common and flowers in the winter, while hysteranthous types (flowering and leafing are separated), flower in the autumn and are limited to north facing slopes. The flowering seasons of the different populations are almost entirely separated with just a short overlapping (Fig 1).

Picture 2.
A hysteranthous *C. persicum* flowering plant (leafless).

Picture 3.
A synanthous *C. persicum* flowering plant (with leaves).

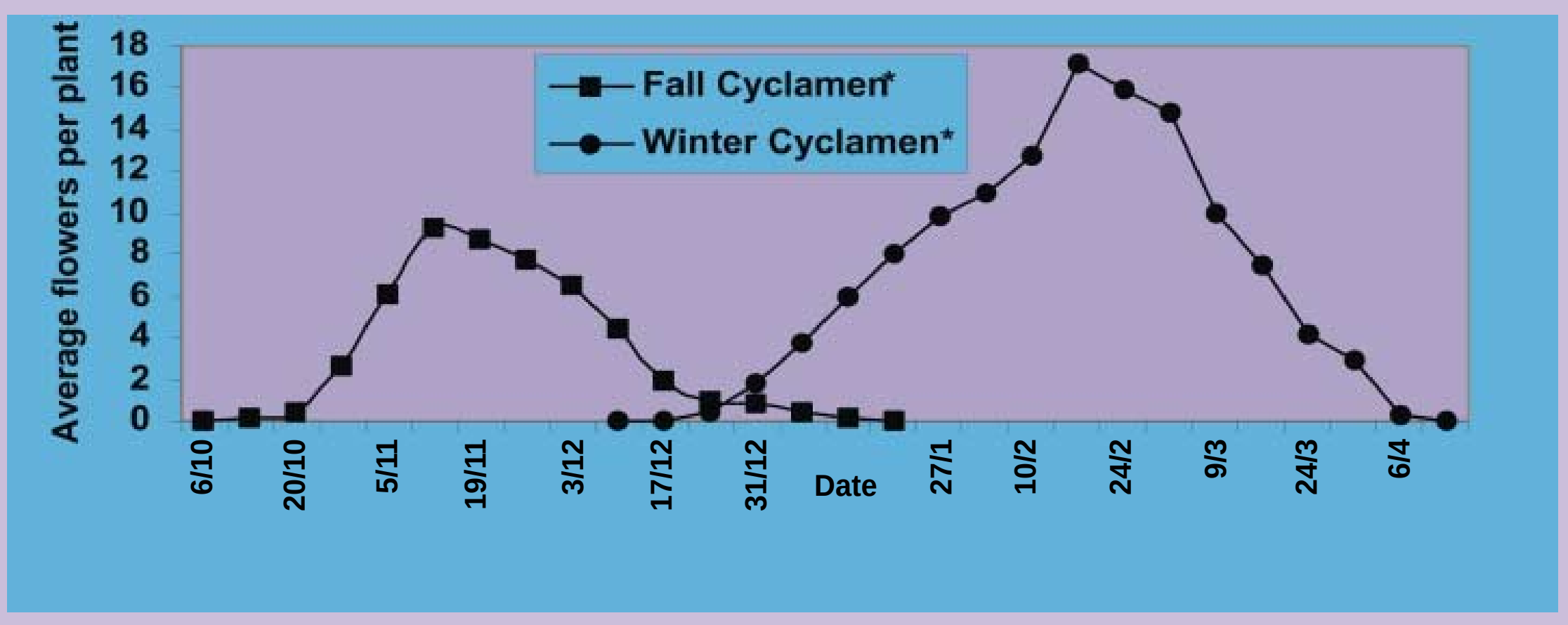

Fig. 1. Flowering course of *C. persicum* in 1996-7. Fall Cyclamen* refers to hysteranthous plants and Winter Cyclamen* refers to synanthous ones.

Pollination by Moths

Picture 4.
The primitive moth *Micropterix berytella* (Micropterigidae) in a feeding position on the bottom of the *C.persicum* flower.

Observations on the dynamics of moths and flowers of *C. persicum* through the season showed a similar pattern (Fig.2). Using video taping the moth was observed pollinating the *Cyclamen* flowers by touching the stigma with its mouth-parts. The moth has chewing mandibles (not a proboscis which is common in the Lepidoptera) which enables eating pollen (Picture 4) that was also identified in the moth's stomach contents. The moth's pollination activity contributes 12.6% to the fruit set, which is significant in comparison to the control (Table 2).

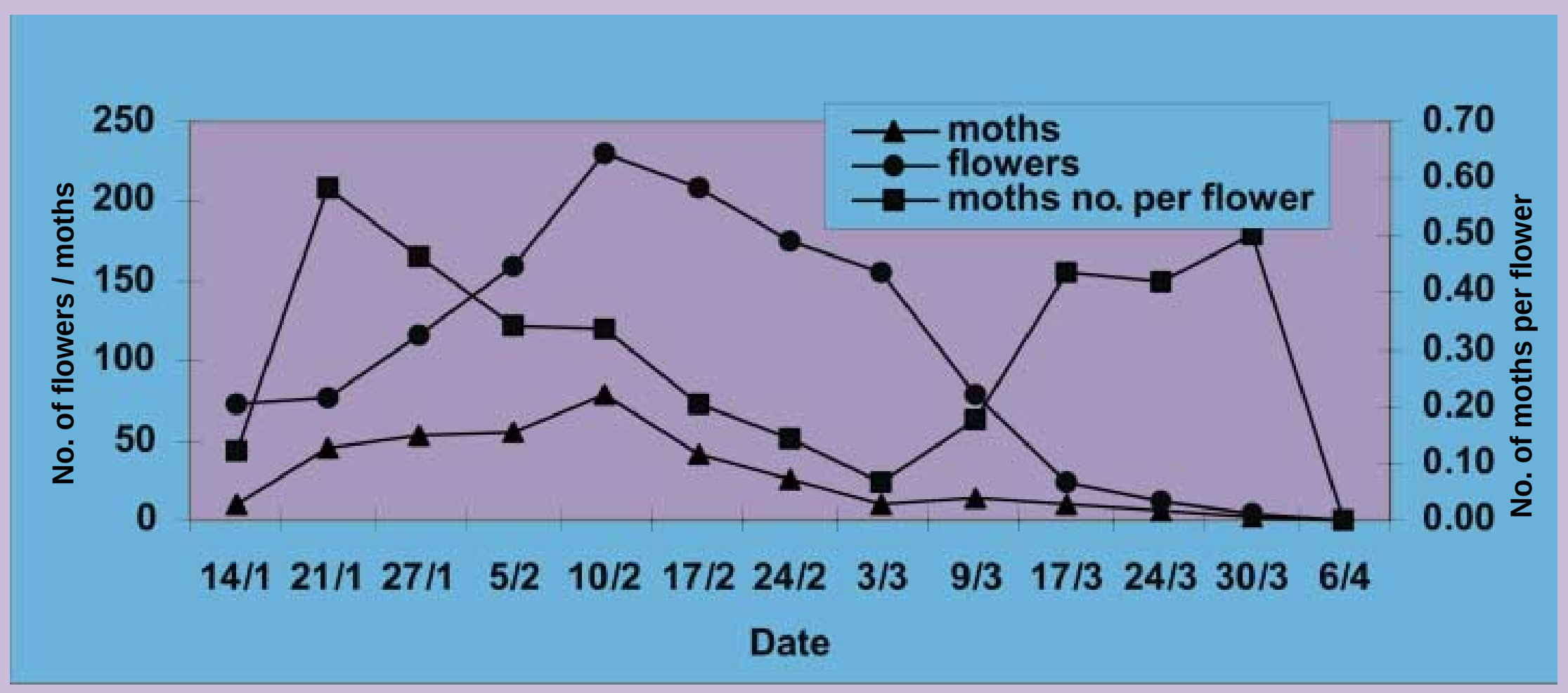

Fig. 2.
Dynamics of *C. persicum* flowers and *M. berytella* throughout the winter of 1997.

Pollination by Thrips

The presence of thrips in *C. persicum* continued throughout the flowering season in both populations (Fig.3). Mature thrips were observed walking and mating on the corolla petals, and different stages of young and mature larvae were found inside the stamens. Thrips' pollinating activity contributed to successful fruit-sets at a rate of 8.2% and 9.4% in the hysteranthous and synanthous populations respectively. These results are significant as compared with the control (Table 2).

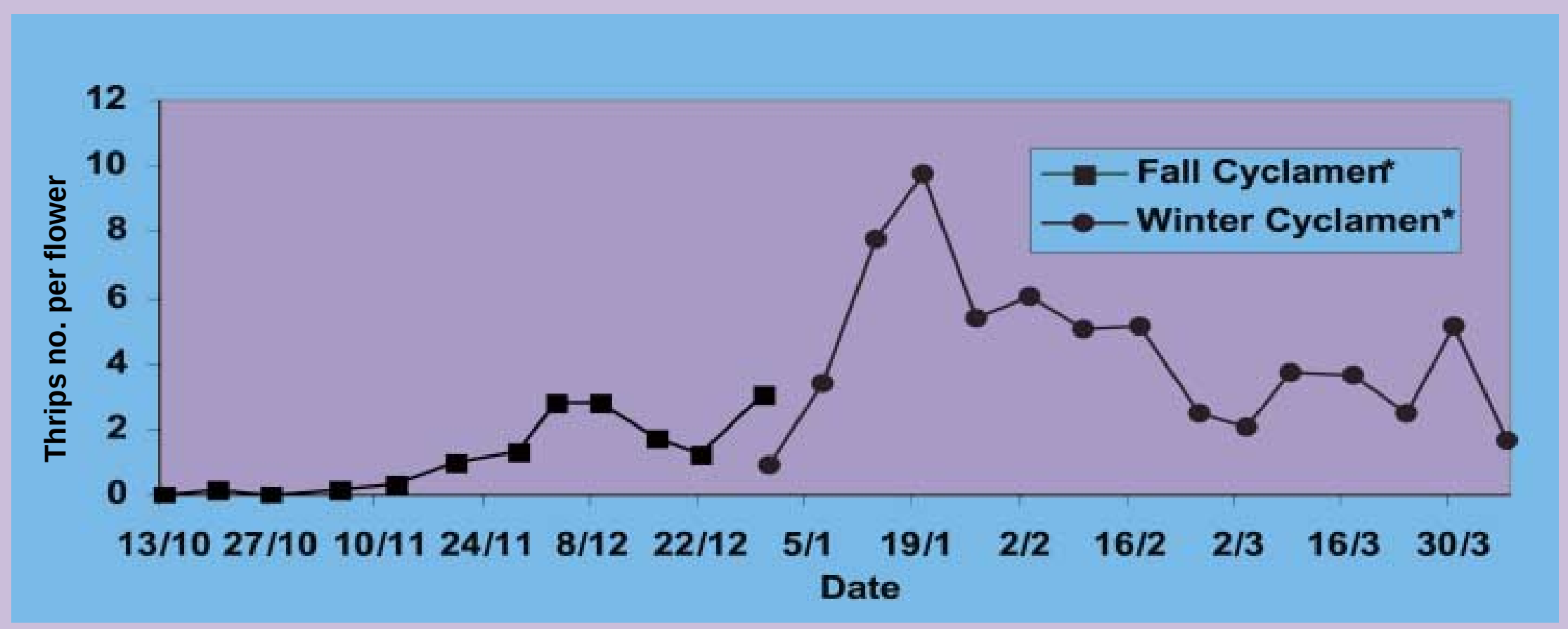

Fig.3. Thrips presence in *C. persicum* flowers in the two populations of 1996/7. Fall Cyclamen* refers to hysteranthous plants and Winter Cyclamen* refers to synanthous ones.

Pollination by Bees and flies

Although bees and flies were rarely observed as pollinators of *C. persicum* (Table 1) their contribution was significant in comparison with the control since the flower was open and receptive over twenty days. They contributed 24.6% and 19.7% of the fruit set in the hysteranthous and synanthous populations respectively (Table 2).

Order	Species	Fall*	Winter*
Hymanoptera	*Amegilla sp.*	4 (4)	0
	Apis mellifera	3 (3)	3 (8)
	"large" bee	0	1 (1)
Diptera	*Myiatropa florea*	1 (1)	0
	Metasyrphus corollae	1 (1)	2 (2)
	Melinda biseta	1 (1)	0
	Pelecocera latifrons	0	1 (1)
	SUM	10 (10)	7(12)

Table 1. Flies and bees visits in the two populations of *C. persicum* during 1996/7. In parenthesis are the number of flowers that were visited by each pollinator. *Fall refers to hysteranthous population and *winter refers to synanthous population.

Picture 5.
Thrips on the corolla "mouth" of *C. persicum.*

Picture 6.
Syrphid fly Metasyrphus corrollae, one of the pollinators of *C. persicum.*

Picture 7.
Honey bee Apis mellifera on flower of *C. persicum.*

Relative contribution of the different pollinators

Picture 8. Perspex cages.

The relative contribution of different pollinators was studied in isolated plants under insect-proof Perspex cages. In each cage we placed three *Cyclamen* plants. At the flowering commencement 20 thrips were introduced once a week into five cages, 10 moths were introduced once a week into five cages and five cages served as a control. Fifteen plants, in the wild, were exposed to natural pollination while 15 other plants were sprayed with an insecticide against thrips and moths to assess the contribution of large pollinators. At the end of each season, we calculated the fruit set which was used as a measure for pollination success.

Treatment no	Treatment	Population	Fruit set	Treat. comparison	Significance
1	Field pollination	Winter	40.1	2 & 4	ns
2	Field pollination	Fall	26.9	7 & 9	s
3	Field pollination + spray	Winter	24.6	2 & 9	s
4	Field pollination + spray	Fall	19.7	5 & 8	s
5	Pollination in cages + moths	Winter	12.6	6 & 8	s
6	Pollination in cages + thrips	Winter	9.4	1 & 3	s
7	Pollination in cages + thrips	Fall	0.82	1 & 8	s
8	Pollination in cages + spray	Winter	0.4	1 & 2	s
9	Pollination in cages + spray	Fall	0.3	6 & 7	ns
				3 & 4	ns

Table 2. Relative contribution of the different pollinator groups in two populations of *C. persicum* during 1996/7. The data was subjected to Replications goodness of fit tests that compares the different treatments. Significant differences, P<0.05, is shown with an "s" and nonsignificant results are marked with an "ns".

Conclusion

The paradigm of "pollination syndrome" suggests that a set of flower traits were selected through an evolutionary process to fit typical traits of the pollinator. The typical anther structure with channeled stamens, is suitable for buzz-pollination by bees. However, we seldom observed buzz-pollination by bees and only in the hysteranthous population. It might be that the *C. persicum* coevolved originally with a large bee which performed buzz-pollination and is now extinct. The vacant flower's niche is now occupied by the monolectic moth *Micropterix berytella. The C. persicum supplies food, shelter, and* a site for mating and laying eggs in a way that suits the *M. berytella* size, senses, mouth structure organs, and its life cycle.

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