The effect of manure management and mass release of pteromalid parasitoids on populations of two pestiferous fly species in dairy farms

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Abstract

One of the major agricultural commodities in Israel is the Dairy Industry. The confined cows produce in a short period of time a large amount of manure, providing optimal conditions for breeding sites of Muscoid flies, such as the housefly (*Musca domestica*) and the stable fly (*Stomoxys calcitrans*). These flies are important pests of livestock worldwide, and not only do they irritate humans and domestic animals, they are also responsible for economic losses in dairy farms, by transferring pathogenic microorganisms, affecting productivity of cattle and reducing their milk yield.

The overall objective of this research was to study, for first time, how the population dynamic of flies is affected by waste management practice and parasitoid wasp release in Israeli dairy farms. The specific goals were to describe the population dynamics of two pestiferous fly species in dairy farms that differ in their manure management practices; to identify the breeding site of each fly species on the farm; to quantify the activity of naturally-occurring predators and parasitoids of flies; to test for the effect of mass-released pteromalid parasitoids on fly populations.

This work was conducted on 10 dairy farms located in the Northern Negev, where each farm had its own schedule of emptying the manure pit and cleaning the path leading from the milking parlor to the sheds. Insects were sampled twice per month during April to October of 2011 and 2012.

Adult flies were trapped with a cylindrical trap made of a white plastic tube covered with a nylon sheet coated with a sticky paste, and with a white commercial sticky strip tape. All traps were set for 24 hours after which trapped flies were identified and counted. In both years and in all the farms, the number of houseflies caught was higher than the number of stable flies. Although the size of housefly and stable fly populations differed significantly among farms, they all showed similar seasonal dynamics. Populations of both species differed significantly among sampling dates. For *M. domestica*, populations started to peak in April in both years; yet the peak ended in June in the first year and in mid-July in the second. Stable fly populations decreased from April to July, probably reflecting an earlier population peak, even before the housefly peak. This temporal population dynamic of the flies may be in response to changes in relative humidity. There was no significant effect of the frequency of emptying the manure pit on housefly and stable fly populations, although there was a trend in the data showing lower densities of houseflies on farms

with more frequent manure removal. Likewise, different frequencies of cleaning the path leading from the milking parlor had no significant effect on housefly and stable fly populations.

Six of the ten farms were randomly selected to evaluate the spatial and temporal distribution of immature flies (pupae and larvae). Breeding material was collected from the following three locations on each farm: the manure pit, the path leading from the milking parlor to the sheds, and the silo where food for livestock is stored. Larvae and pupae were counted separately and their density was scored. Sub-samples were taken and incubated, and the proportion of intact puparia, puparia with fly emergence holes, and puparia with parasitoid exit hole was determined. Emerging adult flies and parasitoids were counted and classified to the species level when possible.

A larger population of immature stages was observed in 2012 compared with 2011, and the number of immature stages sampled decreased progressively with time, a tendency that was not be observed in 2011. In 2011 the main location of immature housefly was the manure pit, and in 2012 there were no significant difference between the number of immature stages in manure pit and in the path. The immature stages of stable fly were found mainly in the path leading from the milking parlor, both in 2011 and 2012. The main predators and parasitoids in the samples were, pseudo-scorpions and Pteromalid wasps (mainly *Spalangia*, *Muscidifurax*, and *Dirhinius* Spp.), respectively. Every two weeks, between May and October 2012, parasitoid wasps (*Muscidifurax raptor* and *Spalangia cameroni*) were released in 5 semi-randomly selected dairy farms (i.e., on one of two farms with similar characteristics). The effect of this release on fly populations was compared with control dairies (where no parasitoids were released) of the same year and with the treated farms on the previous year. For both comparisons, the release of wasps did not affect adult housefly populations significantly.

Evaluation of parasitoid activity was performed three times in 2012 (before, during and after the field release). Bags containing sentinel pupae were distributed on each dairy farm. After a 7-d exposure, the bags were retrieved and pupae were held in ventilated plastic cups for parasitoid emergence. Percentage of parasitized sentinel pupae was similar in both group of farms during the treatment (treated: 10.99% and control: 13.05%) and also after it (treated: 6.27% and control 7.51%). When the number of close pupae was considered as a consequence of host feeding, and added to the parasitized ones, a greater effect of the wasps was observed in the treated farms

(27.99% vs 18.30%). The apparently no effect of wasp release on fly populations may be explain by the relatively late release of the wasps in season.

The study provides useful information about the breeding sites and temporal distribution of in the two fly species on dairy farms. These data are essential for the employment of localized preventive control measures to suppress fly infestations. The results of this study also suggest that frequent manure removal and the proper use of parasitoid wasps may help to reduce the number of flies. Nevertheless, further research is needed for the integration of several tactics to control fly populations in dairy farms.