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Population Fluctuation of Horn Fly (*Haematobia irritans*) in an Organic Dairy Farm

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Abstract: *Haematobia irritans* (Linnaeus) is an economically important pest of livestock. Its infestation causes significant losses in meat and milk production, as well as damaging skin quality. Organic livestock production has increased because of market demands with emphasis on high standards in animal health and welfare and therefore, good production practices are warranted. To achieve this goal, epidemiological studies are needed to devise integrated pest management programs capable of reducing parasite burden to an economic threshold for organic dairy production. Consequently, the objective of the study was to determine *Haematobia irritans* population seasonality and to relate these changes with weather factors. Field phase was developed in an organic dairy farm located in a Mexican temperate climate throughout a 2 years period (2003 and 2004). Weekly horn fly counts and 4 weathers parameters were measured and correlated for each year and years combined. Flies were found on cattle year round in both years the highest loads were 130 flies cow^{-1} in 2003 and 255 flies cow^{-1} in 2004 both in summer. Rainfall showed the highest correlation (r = 0.68) with horn fly in 2004 and for years combined (r = 0.67), while in 2003, it was relative humidity with a correlation of r = 0.75. The lower counts of horn flies on cattle found in winter and early spring were associated with a drier environment and relative lower air temperatures; however, none of the weather factors were severe enough to achieve a complete elimination of flies, the year round presence and summer peaks of flies can be a constraint to animal welfare and production. It was concluded that yearly fly population changes can be associated to weather factors and mild temperatures in winter allows finding flies on cattle year-round.

Key words: Horn fly fluctuation, seasonality, population peaks, animal welfare, dairy farm, livestock

INTRODUCTION

Organic livestock production has been viewed as a plausible ecological approach to milk production. Such a production system involves close inspection of livestock production practices if the management standards and health regulations are to be met besides of being environmentally friendly. A basic concept of organic farming is food production without use of chemicals which includes among others pesticides, herbicides and antibiotics. The postulated advantage put forward is a low risk of finding potentially harmful residues in milk and meat (Borell and Sorensen, 2004).

Important health problems like infestation with external parasites have been noted in organic dairies (Svensson *et al*., 2000). One such problem is the horn fly (*Haematobia irritans* L.) burden in some areas. This fly is a widespread ectoparasite of grazing dairy cattle in tropical, subtropical and temperate climates and it has been well documented that it decreases meat and milk production. Many farmers of organic dairies use alternative or complementary treatments to treat various

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diseases (Kijlstra and Werf, 2005). Yet, little or nothing has been documented to control *Haematobia irritans*. Nevertheless, one necessary step in attempting to control this pest is the definition of the population dynamics in each particular geographical setting. That is, it is of paramount importance to identify the fluctuation patterns of this fly throughout the year to establish drug-free integrated pest management programs (Wagner, 1999) or even to optimize the use of a given strategy to control this parasite. This information should avoid misleading apparent changes in population when in fact changes could have been linked to weather (Castro *et al.*, 2007) or yearly expected fluctuations (Sutherst and Tozer, 1995; Thamsborg *et al.*, 1999).

Thus, the objective of this study was to determine horn fly patterns of seasonality through out the year and to provide basic information on infestation and the possible relationship of a given tendency with weather factors in an organic dairy farm in a determined geographic area in Mexico.

MATERIALS AND METHODS

The field phase of this study was conducted in an organic dairy farm located on the highlands of central Mexico (19°29'N, 98°53'W and 2,240 m.a.s.l.). This region has a temperate climate, mild winters and warm summers (Garcia, 1988). The whole herd was of 25 cows, grazing on pastures all the time, except when in the milking parlour (2 times a day). Alfalfa-orchard grass mixed pastures were used by strip-grazing and cattle were moved to a fresh strip twice a day, after milking. In addition to grazing, cows were fed a concentrate supplement while being milked. Water was freely available.

Horn fly counts were done weekly throughout 2 full years (January 2003 to December 2004) on the entire herd (Guglielmone *et al.*, 1997). These counts were carried out on both sides of each cow by direct observation on pasture (Castro *et al.*, 2005). Concurrently, 4 daily weather parameters were registered: minimum and mean environmental temperatures (°C); relative humidity (%); and rainfall (mm). Fly counts were processed-analysed through descriptive statistics on weekly basis throughout the years. Also a correlation analysis between fly number/cow and corresponding weekly mean relative humidity, minimum and mean temperatures and accumulated rainfall, were carried out. The correlation analysis was done by year and years combined using the CORR procedure of the SAS/SAT software.

RESULTS

As shown in Fig. 1 change in weekly horn fly loads per cow showed a similar pattern in both years. Horn fly counts peaked in summer (mid-July in 2003 and end of

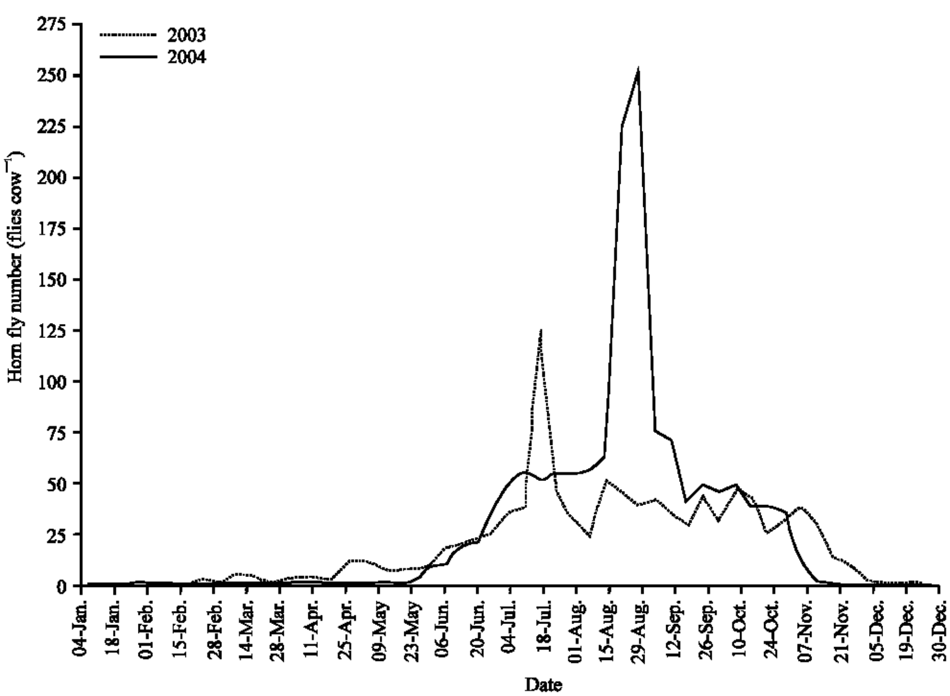

Fig. 1: Number of *Haematobia irritans* flies on grazing dairy cows within an organic dairy farm in the highlands of central Mexico in 2003 and 2004

August in 2004). Apparently unorganized ups and downs in fly population were observed from the end of autumn (December) throughout winter, until the 1st half of spring in April. Horn fly count per cow varied from 0-6, so fly population was negligible in this whole period during the 2 years assessed. By the end of April a steady raise in horn fly count was maintained till the respective peak values in summer. While general trends were similar in both years, specific magnitudes were not. The highest horn fly count in 2003 was 130 and 255 flies cow^{-1} in 2004, almost 2 times higher. If peak horn fly counts are left aside, counts per cow varied from 30-43 and from 40-76 flies, in 2003 and 2004, respectively.

Horn fly count per cow showed a significant ($p<0.05$) correlation in each year and years combined with 3 of the 4 weather parameters measured, i.e.: relative humidity, rainfall, mean and minimum temperature (Table 1). The correlation coefficient between rainfall and horn fly count was almost the same across years and for years combined and higher than the other correlation coefficients in 2004 and for years combined. Only in 2003, relative humidity showed a correlation coefficient with fly count higher than with rainfall.

Relative humidity and minimum temperature relate to horn fly population increase, up to a certain value, after which the relation becomes poor. As rainfall increased from early spring (March) to mid-summer (July), horn fly load per cow also increased (Fig. 2 and 3) and in both years horn fly number peaked after the 1st and before the 2nd seasonal peak of rainfall, number of horn flies at 1st peak in 2003 was 49% lower than the corresponding value found in 2004.

Correlation coefficients between minimum temperature and horn fly count were lower in both years and years combined as compared to the other 2 weather parameters. This was due to the fact that minimum

Table 1: Correlation coefficients and p-values between *Haematobia irritans* count with 4 weather parameters in 2 years (2003 and 2004) and years combined

Year	Weather parameter			
	RH	MiT	T	R
	Correlation coefficient* (p-values)			
2003	0.754 (0.0001)	0.672 (0.0001)	0.205 (0.1403)	0.699 (0.0001)
2004	0.576 (0.0001)	0.536 (0.0001)	0.289 (0.0353)	0.683 (0.0001)
2003-2004	0.530 (0.0001)	0.525 (0.0001)	0.206 (0.0334)	0.674 (0.0001)

*Calculated on weekly records; RH = Relative Humidity, MiT= Minimum Temperature, T= Temperature, R= Rainfall

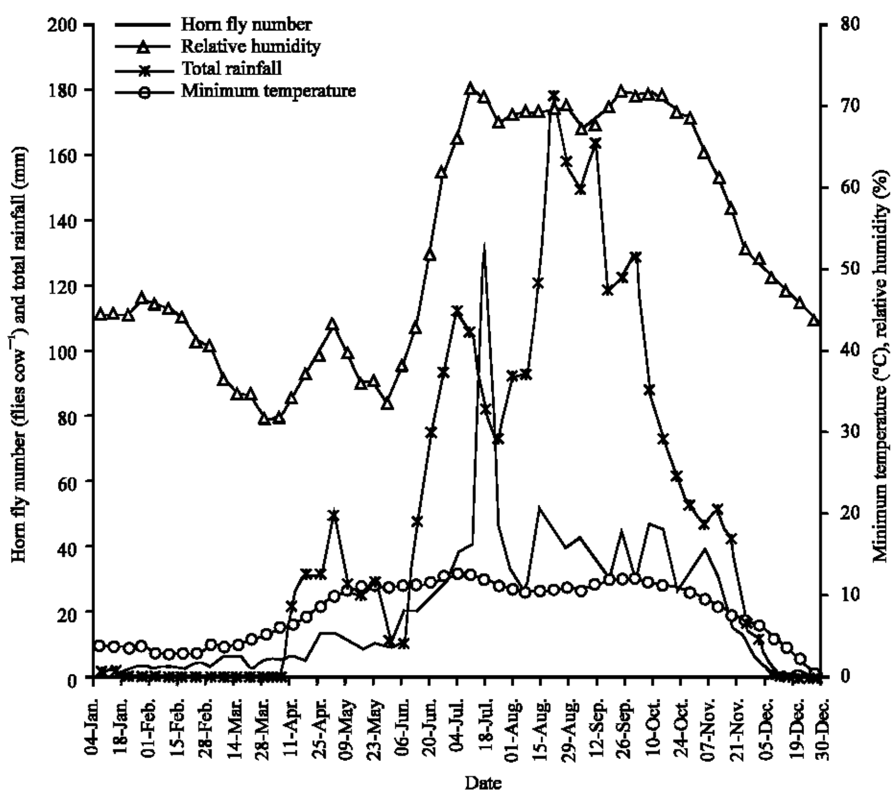

Fig. 2: Trends in the number of *Haematobia irritans* per cow, relative humidity (%), minimum temperature (°C) and total rainfall (mm) in an organic dairy on the highlands of central Mexico in 2003

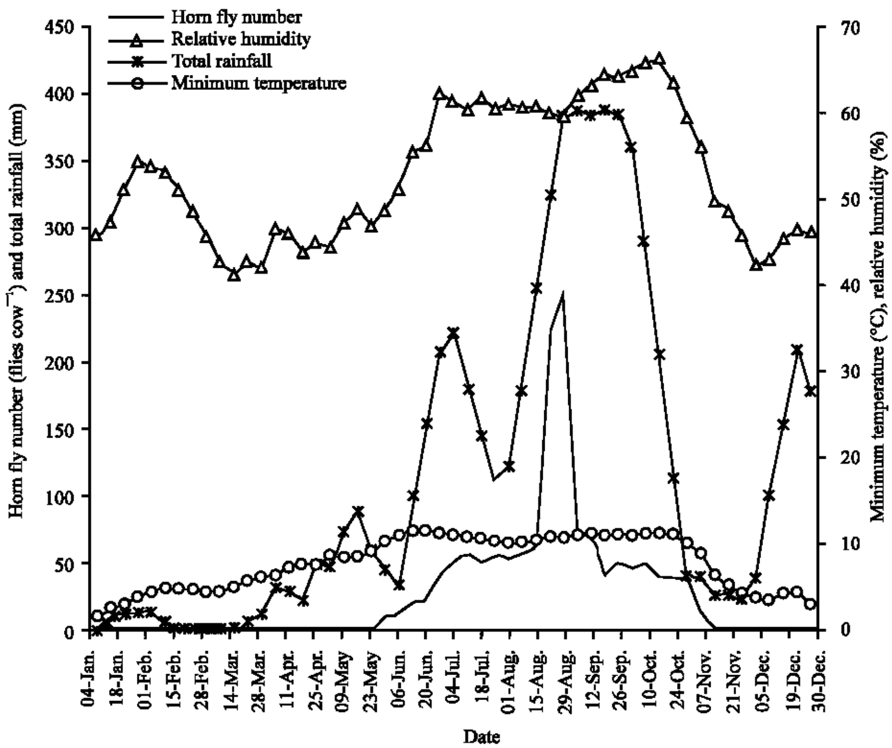

Fig. 3: Trends in the number of *Haematobia irritans* per cow, relative humidity (%), minimum temperature (°C) and total rainfall (mm) in an organic dairy farm located in the highlands of central Mexico in 2004

temperature and horn fly load per cow showed a parallel trend from the end of autumn to spring, but after this time, there were changes in the horn fly load per cow, while minimum temperature remained fairly constant throughout. Rainfall and minimum temperature showed a more stable correlation coefficient value with horn fly count than relative humidity. This latter weather variable registered the largest variation in the magnitude of the correlation coefficient from one year to the other (Table 1). Hence, relative humidity is not a reliable determinant weather parameter of horn fly count.

DISCUSSION

Considering that horn fly population was not controlled by pesticides or predator program management in the organic dairy farm where the study was conducted, the fluctuations in horn fly numbers per cow observed can be taken to reflect mainly the influence of environmental factors (Miller, 1986). Such horn fly changes throughout the year point out 2 major issues: during summer, loads of flies per cows increased to such a level that can easily explain milk yield reduction (Guglielmone *et al*., 1997; Lima *et al*., 2003). This can undoubtedly shift farmer's preferences towards the use of pesticides. Under the mild summer and early autumn of the region, horn fly population showed a single peak, while in another regions (Guglielmone *et al*., 1997; Cruz-Vazquez *et al*., 2000), with warmer summers horn fly population could reach up to 2 peaks within the season and rainfall could not hold a higher correlation coefficient with horn fly per cow because when rainfall reached its highest value, mortality of horn fly larvae is likely to increase (Hughes, 1979; Barros, 2001).

Then, a reflection that can be drawn from this study is that in winter-in central Mexico-environmental conditions restrain horn fly population increments, almost to a point when reductions in milk production can safely be regarded as negligible (Guglielmone *et al*., 1998; Lima *et al*., 2003). Yet, although, the low environmental temperature of this geographic area in winter is highly correlated with low counts of horn fly adult population, such low temperatures rarely reach 0°C or below, hence, a faint, but not complete diapause phenomenon may be occurring. However, the high number of horn-flies found in summer agrees with other reports from tropical and temperate environments (Lysyk, 1992; Maldonado-Siman *et al*., 2006). In contrast, the presence of flies in winter is in agreement with some studies only (Maldonado-Siman *et al*., 2004; Galindo-Velasco *et al*., 2008); others claim that no horn-flies can be found in winter in temperate environments (Gordon *et al*., 1984; Cruz-Vazquez *et al*., 2003).

If organic farming is indeed an option, it is of paramount importance to understand variations in population of horn-flies and to find drug-free procedures and/or programs to achieve an effective pest control program (Entz *et al*., 2008). Meanwhile, organic milk production in this study area, is enduring low productivity in a questionable animal welfare setting. For the region here studied, horn-fly infestation resulted to be a constant problem, from a low count in winter to an intolerable high in summer when the fly burden threshold (255 horn flies cow^{-1}) is easily surpassed (Guglielmone *et al*., 1998; Cruz-Vazquez *et al*., 2003; Galindo-Velasco *et al*., 2008). Hence, a physical and/or biological restrain to *H. irritans* is urgently required if this type of farming is to survive in central Mexico (Sutherst and Tozer, 1995; Wagner, 1999; Angel-Sahagun *et al*., 2005).

CONCLUSION

This study pinpoints the seasonal critical period of the year when horn-fly number increases sharply in a mild temperate climate of central Mexico; yet it also shows that *Haematobia irritans* is found on cattle throughout the year. An economical impact can be deducted and questions the economical viability of organic farming in this area. Also animal welfare in some months becomes a concern.

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