The Use of “Effective Micro-organisms” (WM and EM5) in the Biological Control of House Flies Associated with Poultry Production

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***Abstract**: Two products known as “Effective Micro-organisms” (EM and EM5) were evaluated for use in the biological control of the house flies* Musca domestica *L. and* Fannia canicularis *(L.) that breed in the manure produced in poultry production units. In the first experiment the compounds were mixed with the rearing medium for* M. domestica *and young lervae were placed in it. From the percentage adult flies that emerged from treated and untreated media it was clear that the products had no effect on the development of the flies. In the second experiment larvae of both fly species were added to manure in plastic boxes that were placed in the row of manure that accumulated under the birds and treated with different concentrations of EM and EM5, with and without molasses. It was found that the treatments did not kill the flies, but that the levels of natural parasitism of larvae and pupae were remarkably higher in all the treatments than in the control, in some cases more that 70 % compared to less than 10%. The explanation for this phenomenon is not clear, but it appears that the parasitoids in the poultry production units were attracted to the boxes treated with EM and EM5, and to a lesser extent to those treated with molasses. It is speculated that the application of EM or EM5 to the manure will boost the level of parasitism when used in conjunction with mass released parasitoids for fly control*.

Introduction

When poultry is kept under confined conditions for egg or meat production, manure accumulates and forms a suitable substrate for the breeding of flies. The most common species are the house fly, *Musca dometica* L. and the lesser house fly *Fannia canicularis* (L.). These flies not only irritate the birds, but also people on the premises and in surrounding settlements. Furthermore, they are potential vectors of a number of serious diseases (Kettle, 1990).

House flies are difficult to control with contact insecticides inside production units as the chemicals may contaminate the food of the birds or affect them directly while being detrimental to the natural enemies of the flies. Presently many South African producers add the insect growth regulator cyromazine (Larvadex®) to the food of the birds. It effectively kills the larvae of the house fly, ordinary *Musca domestica* (L) but is less effective in regular doses against the lesser house fly, *Fannia canicularis* (L). However, this approach has its limitations as house flies have in the past become resistant to a wide range of insecticides (Metcalf, 1980; Axtell, 1986) and there is evidence that the continuous use of cyromazine has lead to resistance developing against it (Rutz & Pitts, undated). There is also the possibility that consumers may refrain from buying eggs and meat of birds that were fed with an insecticide if they were aware of the fact.

In view of these problems, it is important that alternative methods of managing fly numbers in poultry production units are found. In this regard, good progress has been made in identifying the complex of natural enemies that attack fly larvae. In the USA and Canada some Pteromalidae wasps that attack mature larvae and young pupae are reared and sold in large numbers to augment the natural enemy complex in the manure. Several species of pteromalids were also found to be present in South Africa. (unpublished results).

In addition, there is the possibility that micro-organisms such as bacteria and fungi may be effective against flies. Anon (1996) mentioned that the product called Effective Micro-organisms (EM) may decrease numbers of flies and ticks in livestock production. We therefore tested this product in the laboratory and field and found some curious results which are reported in this paper.

Materials and Methods

Two products containing micro-organisms were evaluated. The first, named Effective Microorganisms (EM) or Kyusei EM™ Microbial inoculant (EM) is a mixed culture of beneficial organisms consisting primarily of photosynthetic and lactic acid bacteria, yeast, actinomycetes and fermenting fungi. The second, EM5, is a fermented mixture of vinegar, alcohol, molasses and EM (Anon, 1996). Both are available from EM Technologies Inc., Tuscon, Arizona, USA.

The rearing medium of house fly larvae consisting of bran, milk powder and yeast was mixed with different concentrations (2 percent and 6 percent) of EM and EM5 to which (2 percent or 6 percent) molasses was or was not added. The treated medium was placed in plastic 2 liter ice-cream boxes while a box with untreated medium served as a control. About 500 fly larvae (1-2 days old) were added to each of the boxes. The boxes were kept in the laboratory at $\pm$ 25 °C and $\pm$ 60 percent RH. The number of larvae that pupated and reached the adult stage was calculated. The experiment was repeated three times.

In a second experiment, 36 plastic 2 liter ice-cream boxes were half filled with fresh chicken manure (1 to 3 days old) to which 500 fly larvae (5 to 6 days old) of each of *M. domestica* and *F. canicularis* were added and mixed with the manure. The boxes were placed on the row of manure that accumulate under the birds in a randomized block design with six treatments and three repetitions. The treatments consisted of different concentrations of EM and EM5 (16 percent and 100 percent) to which molasses (6 percent and 100 percent) was or was not added. The controls received only water or molasses. The treatments were applied with a small (1 *l*) hand-held sprayer at a rate of 20 ml per box (345 cm^2 surface area). The first application was made after one day and this was repeated twice at 48 hr intervals. Two to three days after pupation the pupae were separated from the manure by immersing the manure in water and retrieving the pupae with a sieve. The pupae were placed in a box so that the unaffected adults could emerge. Pupae from which adults did not emerge were kept under observation until all parasitoids had emerged. The data were analysed in a factorial design with concentration of EM (three concentrations) and the presence or absence of molasses as the main effects. Data for the two EM's (EM and EM5) and the two fly species were analysed separately.

Results

Treatment of the rearing medium with EM or EM5 did not affect the development of one to two day old larvae (Table 1). ANOVA indicated that there is no significant differences between treatments in respect of the number of survivors at the various concentration levels used ($p>0.05$). A similar result was found (not shown) when EM and EM5 were sprayed onto manure in boxes with larvae. However, a curious, but striking result was the increase in the level of parasitism relative to the control in the treatments where EM and EM5 (with or without molasses) were applied (Figure 1). The parasitoids that emerged were small wasps of the family Pteromalidae.

There were significant interactions between concentration and presence or absence of molasses in the case of *M. domestica*. However, the differences in main effects were highly significant indicating that there were differences between concentrations and between presence or absence of molasses. At a concentration of 6 percent EM and EM5 there was a marked increase in parasitism of *M. domestica* from about 10 percent for the control to about 80 percent. The application of molasses by itself also appeared to result in an increase in the level of parasitism. This difference due to molasses was not evident at 6 percent and 100 percent EM. This probably results in the significant interactions.

In the case of *F. canicularis* there were no interactions between the presence or absence of molasses and the EM concentration (Table 2). There was also a marked increase in the level of parasitism between 0 and 6 percent EM (Figure 1) and a consistent, but smaller, increase in parasitism, due to the presence of molasses. The differences due to the addition of molasses were significant (Table 2).

Table 1. Percentage Flies Reaching the Adult Stage when Reared from Larvae in Media Treated with Different Concentration of EM and EM5, with or without Molasses

Treatment	Number of Larvae	Number of Pupae	Number of Adults	% Adults
EM5 2%	671	641	629	93.74
EM5 2% + Molasses 2%	723	685	675	93.36
EM 2%	612	609	600	98.03
EM 2%+Molasses 2%	548	531	525	95.80
EM 5 6%	446	433	428	95.53
EM5 6% + Molasses 6%	650	629	620	95.38
EM 6%	633	608	600	94.78
EM 6% + Molasses 6%	572	561	549	95.97
Control	715	694	681	95.24

Table 2. Probability Levels for Interactions and Main Effects from the Factorial Analyses of Data Using the Two Fly Species and EM Formulations

Fly Species	EM	Interaction	Concentration	Molasses
M. domestica	EM	<0.001	<0.001	0.004
M. domestica	EM5	0.032	<0.001	0.002
F. canicularis	EM	0.314	<0.001	0.026
F. canicularis	EM5	0.200	<0.001	0.011

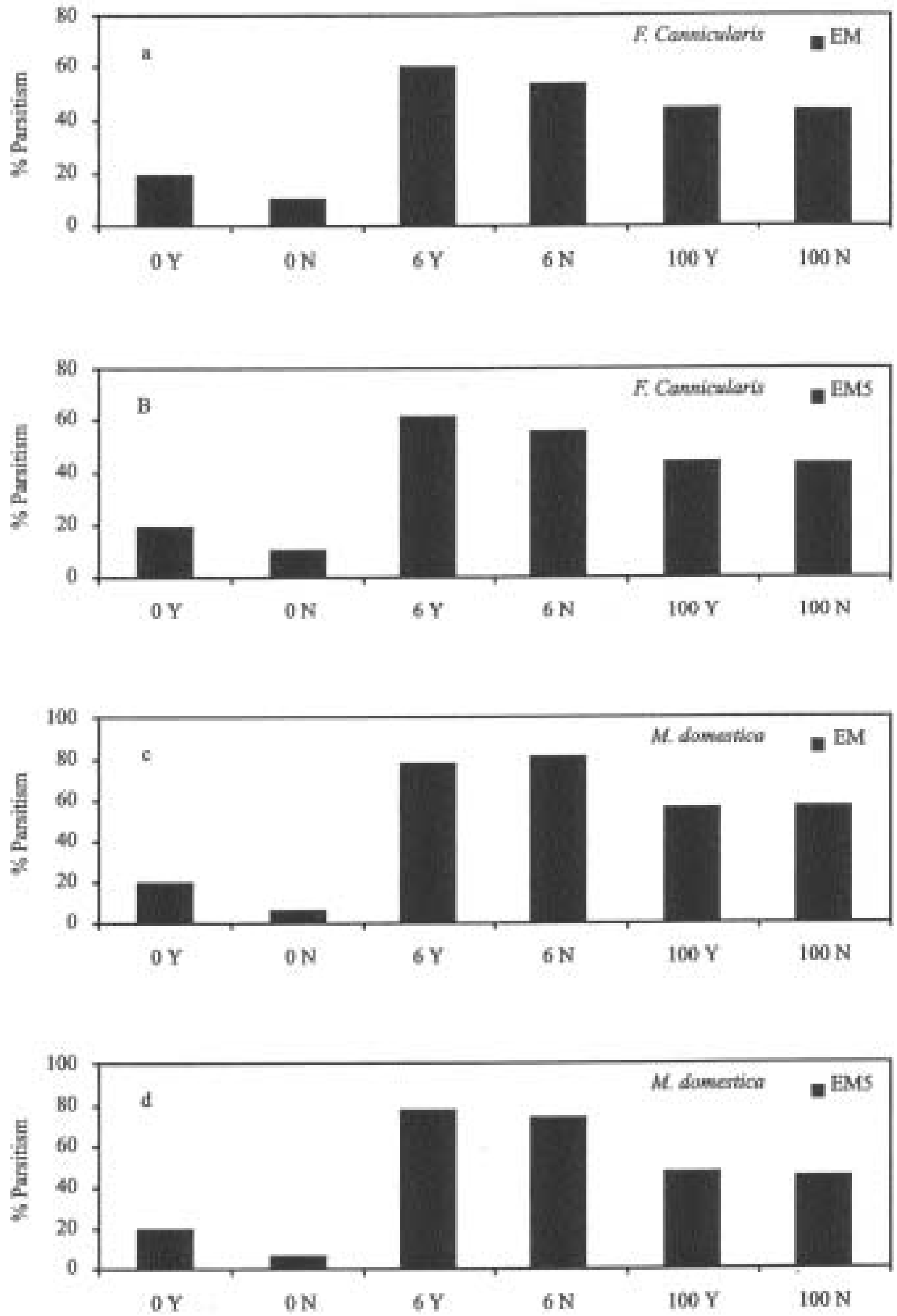

Figure 1. Percentage Parasitism of Two Fly Species Occuring in Poultry manure Treated with Different Concentrations of EM and EM5 with and without Molasses. O Y = 6% molasses; O N = water only; 6 Y = 6% molasses + 6% EM/EM5; 6 N = 6% EM/EM5; 100 Y = 100% molasses + 100% EM/EM5; 100 N = 100% EM/EM5.

Discussion

Our experiments showed that EM and EM5 can not be used as a direct agent against older fly larvae or pupae. It is also ineffective in killing adult flies (unpublished results).

However, the increase in the level of parasitism of the fly larvae and pupae compared to the control, was remarkable and unexpected as EM5 is considered to be an insect repellent (Anon, 1996). In the case of *M. domestica* it rose from less than 10 percent to about 80 percent. At this stage it is not possible to explain the phenomenon. Possibly the parasitoids that were present inside the poultry units were strongly attracted to the patches (boxes) sprayed with the EM and EM5. If this is so the implication is that the level of parasitism in the unsprayed parts of the manure will be reduced so that the general level of parasitism in the unit remains the same. However, there may be other explanations, for example, the treated fly pupae may become more susceptible or attractive to the parasitoids, or the parasitoids may somehow be stimulated by the EM products. All these aspects should be investigated. Furthermore, the EM products could prove to be very useful in conjunction with mass reared and released parasitoids for biological fly control through the augmentation of the existing parasitoids. If sprayed on the rows of manure it may help to enhance the process through one of the mechanisms mentioned above.

Conclusion

The use of insecticides to control flies in confined poultry production units may affect the birds, workers, consumers and the environment. It may also ulitmately be unsustainable as a result of the development of resistance. Therefore biological means of fly control should be fully utilized. The products EM and EM5, which contain natural micro-organisms were found not to have killed fly larvae, pupae or eggs. However, when applied to small containers with fly larvae at a concentration of 6 percent (with or without molasses) they increased the level of natural parasitism to very high levels. How this can be explained and utilized is not clear at this stage.

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