EVALUATION OF THE EFFICACY OF FAN-BASED LUMINOUS TRAP SYSTEMS IN PROTECTING LARGE PIGS FROM MOSQUITO BITES

INTRODUCTION AND OBJECTIVES OF THE RESEARCH

In the last 30 years the area of Lomellina Pavese, distinguished by large expanses of rice fields and water meadows, has evolved towards developmental zootechnical activities with the aim of attaining important status in the national arena: above all, the raising of large pigs for the production of ham is the activity that waves the flag.

The particular process to which the pigs are subjected requires that the butchered meat be free from any kind of modification in order that, during the months of maturation, it is possible to verify the complex changes to the muscle fibre and fat tissue that lead to the organoleptic and nutritional characteristics that have made Italian hams famous throughout the world.

In this context, the problem of mosquitoes that develop in the rice fields is a very sensitive one: every time the rice field is cleared, whether for agronomical reasons or through water shortages, one of the most troublesome species, Ochlerotatus Caspius, deposits its eggs in the damp earth.

When the water returns to the rice field, it makes the eggs hatch, and the larvae, no longer encountering any predators, which have disappeared owing to the dry conditions, can complete their development and produce a huge population within a very few days.

The stocks of pigs placed in the rice fields, powerless when faced with the implacable attacks of the mosquitoes, produces animals afflicted with visible cutaneous lesions produced as a reaction to the bites. In such conditions, these papules can remain for many days, and, during butchering, are a reason for rejecting the legs which were destined for the production of ham (fig. 1). In some cases, for the areas in question, the percentage rejection through disease

fig. 1: Hams with obvious signs of mosquito bites. In some cases the roseate mark extends to the fat area.

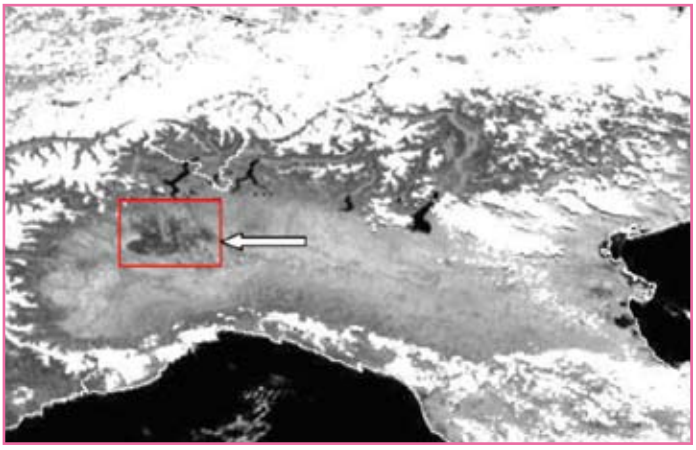


fig. 2: Rice-growing area of the Po valley. Meteosat 8 photograph dated 8/5/2005. Source: P. Marcacci and P. Monelli (CESI)

reaches values which are distinctly higher than the national average (4.7%), causing serious economic damage to the entire production chain.

The techniques for control of pest infestations that have been used up until now by breeders consist in the frequent application of insecticides which give results of extremely short duration and high costs for the products and the associated labour.

The construction of physical barriers, such as mosquito screens, is not easily practicable because the nets tend to become clogged, impeding the flow of air inside the breeding area.

Anti-larval treatment of the rice fields could also be an effective method if it were made part of a co-ordinated, large-scale campaign (the rice-growing area in question extends over 2000 square Km on the plain between Piedmont and Lombardy (fig. 2)).

In such a situation, any solution considered seems to be at once hazardous and improbable, but from an experimental trial carried out in summer 2006 in three pig fattening farms located in the rice growing areas of the province of Pavia, the possibility arose of obtaining significant results through the use of high capacity luminous traps known as "Turbines", developed and produced by MO-EL S.r.l.

The main objective of the experiment was to verify, in a live context, the applicability of a strategy whereby the likelihood of capture using a system of luminous high-power traps exceeded the influx of mosquitoes from the rice fields, thus creating an element of environmental resistance capable of reducing the number of insects entering the farm.

In practical terms, it was a case of understanding whether such a control system, which does not act upon the speed of growth of the population in the rice field, was nevertheless able to form an effective protective barrier around the piggery such as to noticeably reduce the effects of the bites inflicted by these blood-sucking insects on the pigs being raised and thus able to convert their legs into quality hams.

MATERIALS AND METHODS

Organising, setting up and activation of the luminous trap equipment on the farms being analysed.

The experiment was carried out between March and September 2006 on heavy pig farms located in the rice growing areas of Lomellina Pavese.

The organisation and setting up of the luminous trap equipment was done with the aim of protecting the pigs during the winter-spring and/or spring-summer fattening season, the butchering of these animals occurring between June and September, in other words during the most critical period of the mosquito invasion.

In all, the three installations comprised 50 "Turbine" traps positioned for the protection of 13,500 animals distributed inside 18 sheds (table 1).

As an aid to implementing the project, maps from aerial photographs were used to analyse the nature of the surrounding rice growing area.

FEATURES OF THE TURBINE TRAPS

The Turbine luminous traps, designed to capture very large amounts of insects, use two 40W ultraviolet lamps as a means of attraction (emission peak at 365 nm wavelength) positioned frontally and vertically on the appliance.The capture system consisted of a draught of

table 1: Technical specifications of the experimental equipment used.

	NO. OF PIGS MONITORED DURING FATTENING CYCLE	NO. OF SHEDS PROTECTED	NO. OF TURBINES USED	TYPE	PERIOD OF SLAUGHTER
FARM N°. 11	1000	1	8	COLLECTIVE SHEDS WITH FLOOR PARTLY SPLIT AND EXTERNAL DEFECATION AREAS. ARTIFICIAL VENTILATION	JUNE
FARM. N° 12	3500	9	20	COLLECTIVE SHEDS WITH FLOOR PARTIALLY SPLIT AND EXTERNAL DEFECATION AREA. ARTIFICIAL VENTILATION	JULY
FARM N° 13	9000	8	22	COLLECTIVE SHEDS WITH FLOOR TOTALLY SPLIT .ARTIFICIAL VENTILATION.	SEPTEMBER

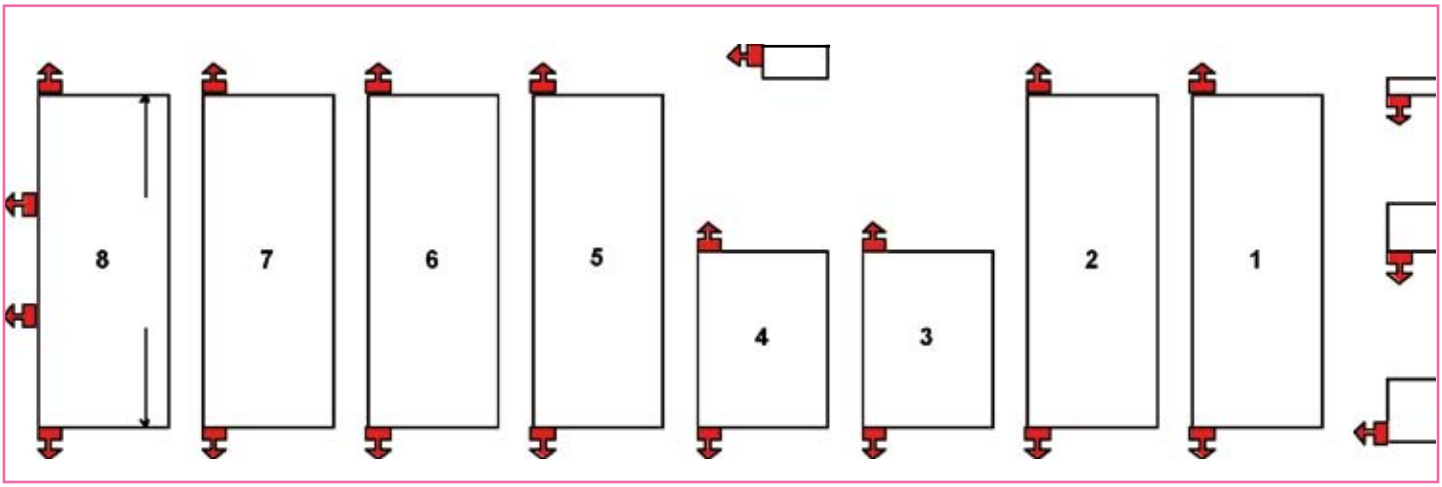
air created by a horizontal fan placed under the appliance.
Insects attracted by the light are blown through the slots placed behind the lamps into a collecting bag, where they die from dehydration (fig. 3).

PLACEMENT OF THE TRAPS

The "Turbine" traps were placed along the perimeter of the sheds about 25m apart and facing outwards, so as to form a protective barrier between the animals and the rice fields (fig. 4).
The mosquitoes arrived en masse from the rice fields, from up to a few km away, attracted by the continuous emissions of carbonic anhydride produced by the pigs, and collected in the air by the extractor fans positioned on the headboards of the sheds.
To demonstrate the extent of the attractive power exercised by the pigs on the mosquitoes, the number captured after the sheds were emptied on slaughter of the pigs fell by at least one order of magnitude, and then returned to "normal" with the return of the new fattening cycle.
Weekly collection of the insects, quantitative and qualitative evaluation of the captures.
In this project a multidisciplinary study was initiated with the synergistic involvement of the farm managers, qualified veterinarians, MO-EL engineers and the University framework, with the application of a monitoring protocol which in addition to the evaluation of the captures made by the luminous traps, involved the placement of adhesive panels inside the sheds and visual monitoring of the pigs for signs of mosquito bites.
Every activity was documented, with appropriate tables drawn up to record the data and observations.
The captures made by every luminous trap were quantified weekly by weighing the collected insects and comparing the result with the

fig. 3: Turbine trap mounted outside a shed.

fig. 4 plan of farm no. 13 with positioning and orientation of the luminous traps.



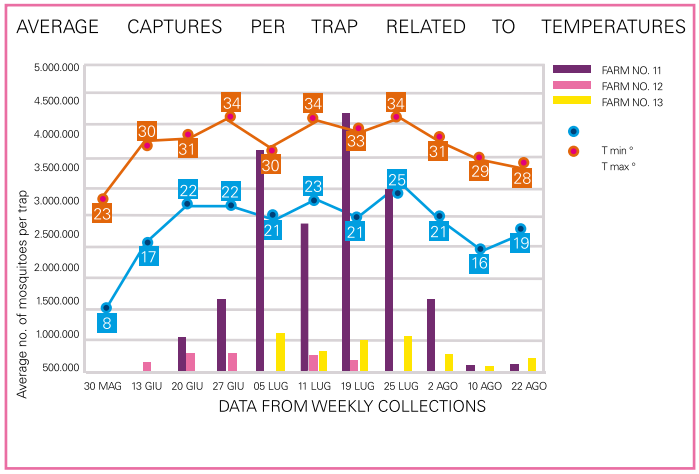


fig. 5: Graphic comparing average weekly mosquito captures per trap made on the three farms

number in one gram, which was calculated at 400 on average.
The quantitative and qualitative evaluation of the presence of mosquitoes within the sheds was done in farm no. 11 by the use and replacement on alternate days of adhesive panels (internal use of the luminous traps is inadvisable).
Visual control of a sample of three suitably marked pigs was instead carried out in farm no. 12, with weekly production of photographic evidence to show the existence of the bites and their decline over time for comparison with the results from previous years; however, the farm managers were also asked to carry out the same infestation control procedures and activities used during previous years.

RESULTS CAPTURES MADE WITH THE LUMINOUS TRAPS

As can be seen from the graphic in fig. 5, the data acquired in general closely follow atmospheric temperatures, showing an exponential growth in captures from the end of May and a progressive reduction towards the end of July, caused by a big storm which resulted in a net reduction in minimum temperatures. In comparing the weekly collections from the three farms, those from farm no. 11 stand out; a good 116 million insects were eliminated, with an average capture rate of 1,319,795 mosquitoes per trap. In farms 12 and 13, the average capture rate was 214,060 and 384,953 mosquitoes per trap respectively (table 2).This remarkable difference in numbers, as revealed between the captures made in farm no. 11 as opposed to farms 12 and 13, denotes the existence of infestations of differing extents depending on their distance from the rice fields: in fact, farm no. 11 is very close to the rice fields, whilst in the other 2 cases the breeding grounds are a few km away. This also explains why the presence of mosquitoes in the first farm was heavy all day long (especially in shaded areas) and reached alarming proportions right from the first sunset, while in the other two farms the situation only became critical during the evening, or after the time required for the mosquitoes coming from further away to reach the farms.

COMPOSITION OF THE CAPTURES

From an analysis of the captures made, Ochlerotatus Caspius, a typical mosquito from the rice fields, especially between April and July, was shown to be the most numerous species (60% in farms 12 and 13, 75-80% in farm 11). Mosquitoes of the genus Culex Spp. represented nearly all the rest of the captures, except for a small percentage (1-2%) of mosquitoes belonging to the Anopheles Maculipennis group.

CONDITIONS INSIDE THE SHEDS AND ON THE PIGS

table 2: Full data relating to mosquito captures made by the Turbine traps.

	NO. OF TURBINES USED	TOTAL MOSQUITOES CAPTURED	NO. OF COLLECTIONS MADE	AVERAGE CAPTURES PER COLLECTION	AVERAGE CAPTURES PER TRAP PER COLLECTION
FARM NO. 11	8	115.142.000	11	10.558.364	1,319.795
FARM NO. 12	20	29.968.400	6	4.281.200	214.060
FARM NO. 13	22	59.282.800	7	8.468.971	384.953

In all cases, the structure of the sheds was such as to allow for easy access by the mosquitoes via numerous openings positioned along the sides and on the roofs, and, in the case of farms 11 and 12, into the external defecation areas where the animals often stood.
In general, the captures made inside the sheds with the adhesive panels, and the visual checks made on the pigs selected as samples, faithfully reproduced the results obtained with the external luminous panels, and grew in importance as the infestation progressed.
As regards the consistency and course of the lesions inflicted by the mosquito bites on the sample pigs observed, a development of papulo-ponfoidi bite marks was observed, followed by scabs that often took more than 30 days to heal.
This length of time is probably related to the ambience of the piggery, to the dubious hygiene conditions and to the sensitivity of individual pigs.

PERCENTAGE OF REJECTIONS AT SLAUGHTER

During the trimming operation performed at butchery, the legs intended for making ham are subjected to a rigorous selection process in which evident imperfections such as mosquito bites, haematomas and effusions, constitute a reason for rejection and destination for other uses (in such cases, 70% of the rejections are generally due to mosquitoes, 20% to haematomas and 10% to effusions).
Inside the three experimental farms, cognitive investigations were carried out, together with technical trials and the collection of useful data so as to gain a deeper understanding of the problem and to develop an effective strategy for control.
Unfortunately, as far as the data relating to the percentage rejection during butchery is concerned, the parameters needed to make a detailed comparison with previous years or with similar situations for reference purposes are only available for farm no. 11 (table 3), in which a net reduction in the percentage of rejections was observed when compared with the previous year (8.32% against 18.59%) and with a local farm with similar characteristics (24% average rejection rate).
The data collected indicates that in June 2006, even though not reaching the maximum level, the infestation in farm no. 11 was high and the comparisons made with similar situations enable an estimate of potential losses to be made.
The butchery of the pigs produced from farm no. 12, even though during the period of highest infestation, gave an average rejection rate of about 12.56%.
Finally, the results from farm no. 13 were much lower (0.8% of legs were rejected) since they are due not only to the capture system implemented but also to two other fundamental factors: the clearing of the rice fields for the rice harvest (which determined the subsequent fall in infestations) and the closure of the sheds for cooling with compressed air during August.
However, this cooling system is only suitable to certain types of shed and is set to be interrupted at night (when the temperature falls below 23° C) by opening the windows and thus allowing the mosquitoes temporary ingress.

fig. 5: Graphic comparing average weekly mosquito captures per trap made on the three farms

PERIOD OF SLAUGHTER	NO. OF LEGS BUTCHERED	NO. OF LEGS MARKED	AVERAGE REJECTION %
FARM NO. 11 (COMPARISON WITH DATA OBTAINED DURING PREVIOUS YEAR)			
JUNE 2006	1924	160	8,32%
JUNE 2005	4094	761	18,59%
SIMILAR FARM NOT INCLUDED IN PROJECT FOR CONTROL WITH "TURBINE" TRAPS (DATA FROM JUNE 2006)			
JUNE 2006	NP	NP	24,00%

DISCUSSION

In conclusion, the experiment conducted in Lomellina Pavese, one of the most critical areas in Italy for the presence of mosquitoes, forms the basis for a strategy of containment of infestations from flying insects that can be applied, without structural distinctions, to all emergency and non-emergency situations in which, for various reasons, it is not possible to act effectively on the original breeding grounds.
The enormous volumes of insects captured by the luminous traps are such as to reduce the amount of infestation inside the farm or other area to be protected, creating an environmental resistance factor in proportion with the number of appliances placed and the level of infestation encountered.
It is considered therefore that the use of strategies of this kind can, in many cases, be of great help when carrying out other insecticidal operations which are more expensive, have an environmental impact and are only effective in the long term.

THANKS

The authors wish to thank Dr. Giovanna Martelli, veterinary researcher for the Dept. of Morphophysiology and Animal Production of the Faculty of Veterinary Medicine at the University of Bologna, for her suggestions on the causes of rejections for Parma and St. Daniele hams.

BIBLIOGRAPHY

- Proceedings of the EMCA International Symposium EMCA - Mosquitoes and Rice Fields, not just a Piedmontese, Alexandria 12/10/2006

- R. Bellini et al. 1999 – Il Divulgatore (The Divulger)

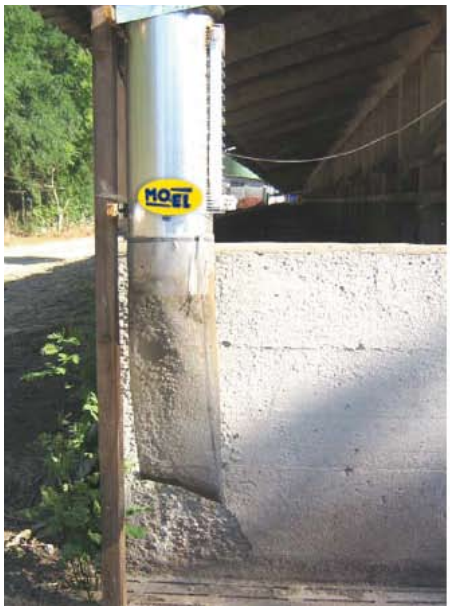
- M. Huancahuari, 2006 - Distribution of Diflubenzuron (IGR) during rice sowing for the control of mosquitoes. Disinfestation & Environmental Hygiene September/October, pp. 56-59.

- A. Talbalaghi, 2000 – Control of Mosquitoes (Diptera: Culicidae) in the province of Southern Alessandria in Piedmont. Proceedings of the 13th European SOVE meeting, p. 79.

- A. Talbalaghi, 2004 - Mosquitoes: management of the problem over time and experiences. Disinfestation & Environmental Hygiene July/August, pp. 48-55.

- F. Zanella, 2000 - Biocenosis of rice fields with particular reference to Culicidae. Disinfestation & Environmental Hygiene

Captures at three different times.



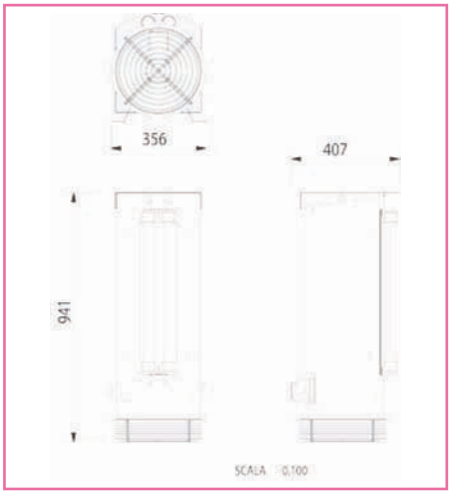
TURBINE
mod. 306

15-18 m

CE

ALUMINIUM

NEW



EFFICACY OF THE TURBINE'S ACTION

The Turbine is of particular value in rural areas and on farms.

In these environments, the use of chemical insecticides or pesticidal equipment that releases gaseous substances could damage crops or the health of animals. Turbine, on the other hand, uses the attractive action of its lamps on flying insects. When they reach the front window, they get sucked in by the action of a fan powered by an electric motor, and deposited in the lower part of the appliance, from where they cannot escape. The external structure, fan and housing for the electrical components are all made from metal to guarantee the strength of the appliance.

METHODS OF USE

The Turbine ELECTRIC INSECT KILLER has IPX4 protection, as required by law for external use. It is fixed to a wall with rawlplugs. In order to enable infrequent disposal of the captured insects, the net collection bag has a volume of 25 litres.

SAFETY

Turbine is a safe appliance and presents no risk of inflammability. It does not emit smoke, radiation or electromagnetic waves that could disturb the animals. It does not use chemical attractants that need replacement.

TECHNICAL SPECIFICATIONS	
Dimensions in mm	407x356x941 mm
Weight	11 kg
Input voltage	230-240 V/50Hz
Total power consumption	165 W
Actinic lamps	2x40W
Duration of lamps	2000 h
Range of operation (m)	15/18 m
Fan rotation speed	1000 rpm
Air intake volume	4 m/s
Insulation class	I
Water protection level	IPX4

SPARES	
0802	40W lamp
002869	Net collection bag