

Valuation of the effectiveness of a system of aspirating luminous traps to protect heavy pigs from mosquito bites

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KEY WORDS: Ham, Rice fields, *Ochlerotatus caspius*, Luminous traps

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Introduction and aim of the research

In the last 30 years the Lomellina pavese territory, characterized by vast areas of rice fields and water meadows, has also evolved towards zoo technical activities that have developed and obtained important positions in the national field: firstly, heavy pig breeding for the production of ham certainly covers the role of standard-bearer. The particular work process which the pork legs undergo requires the slaughtered meat to be free from alterations of any type so that, during the months of seasoning, complex modifications of the muscular and adipose tissue take place leading to those organoleptic and nutritional characteristics which have made Italian ham famous worldwide.

In this context the problem of the mosquitoes that develop in the rice fields is very much felt: each time the rice field is emptied, for agronomical purposes as well as for water shortage, one of the most bothersome species, *Ochlerotatus caspius*, lays its eggs in the humid soil. The water, returning to the rice field, makes the eggs open, and as a result of the dryness, the larva, no longer finding any predators, can complete their development creating in a few days a population of enormous size. The pig farms found in the rice fields, helpless in the face of the implacable aggression of the mosquitoes, show animals with evident skin lesions that are a reaction to the bites obtained. In such conditions these papules can persist for many days and, during slaughtering, represent a cause of waste for those legs destined for ham processing (fig. 1). In various cases, for the areas in question, the percentage of waste caused by pathology reach values that are clearly above the national average (4,7%) causing serious economical damage for all the industry.



fig. 1: Ham with evident signs of mosquito bites. In various cases the red ring extends to the layer of fat.

The techniques adopted up to now by the farmers to control mosquito infestations, consist in carrying out frequent insecticide treatments which give short lasting results with high costs for the products and manpower. The creation of physical barriers, such as the application of mosquito nets, is not an easily realizable technique since the nets tend to get clogged up and therefore, prevent the change of air inside the farm. In addition the anti larva treatment of the rice fields could be an efficient method if it were part of a coordinated campaign project on large scale (the rice growing area in question extends for 2000 Km² in the lowland between Piemonte and Lombardia; fig. 2).

Faced with such a reality, any idea at first seems risky and improbable but, the test carried out during the summer of 2006 in 3 pig fattening farms in the rice growing areas of the province of Pavia, showed that it was possible to obtain an appreciable result through the use of luminous aspiration traps with a high capture capacity, called "Turbine", developed and produced by Mo-EI S.r.l.

The main aim of the test was to verify, in a real context, whether the appliance of a strategy whose capacity of capture, thanks to a system of high power luminous traps, would exceed that of mosquito invasion coming from the rice fields, thus creating an environmental resistance factor able to reduce the number of these insects inside the farm. In practice it was a matter of understanding whether such a control system, that does not act on the speed of growth of the population in the rice field, is however able to create an effective protective barrier inside the pig sty such as to notably reduce the effects of the bites inflicted by these hematophages on the pigs and therefore, on the transformation of their legs into quality ham.

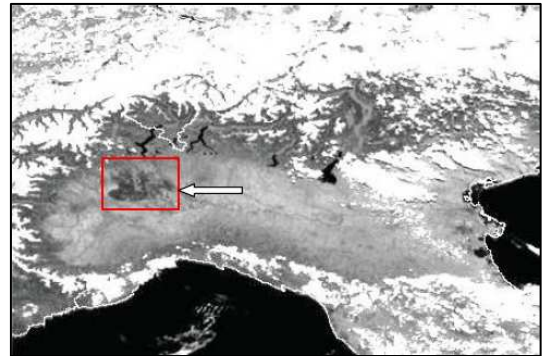


fig. 2: Rice growing area of the padana lowland. Meteosat 8 photo of 8/5/2005. source P. Marcacci and P. Monelli (CESI)

Materials and methods

Planning, set up and activation of the luminous trap systems at the farms being analyzed

Testing was carried out from May to September 2006 on three heavy pig farms located in the rice growing areas of Lomellina pavese.

Planning and set up of the luminous trap systems was carried out in order to protect the pigs for fattening in the winter-spring and/or spring-summer cycle, whose slaughtering takes place in the period between June and September, that is the period when the invasion of mosquitoes is most critical. All the three systems set up included 50 "Turbine" traps positioned to protect the 13.500 animals inside 18 barns (tab. 1). To help carry out the various projects aerial maps of the area were used to analyze the characteristics of the surrounding rice growing territories.

	N° of pigs monitored for the fattening cycle	N° of protected barns	N° of Turbine used	Type	Period of slaughtering
Farm n°1	1000	1	8	Collective boxes with partially "gapped" floor and outdoor defecation area. Artificial ventilation	June
Farm n°2	3500	9	20	Collective boxes with partially "gapped" floor and outdoor defecation area. Artificial ventilation	July
Farm n°3	9000	8	22	Collective boxes with completely "gapped" floor. Artificial ventilation	September

tab. 1: Technical characteristics of the test systems prepared.

Characteristics of the Turbine traps

The luminous traps, designed to face massive captures of insects, are characterized by the presence of two ultraviolet 40 W lamps (emission peak at wavelength 365 nm), which attract the insects, and are positioned in the front part of the equipment in the vertical position.

The capturing system is made up of a flow of air created by a horizontal fan in the lower part of the equipment. The insects attracted by the light are aspirated through slits positioned behind the lamps and conducted to a collection bag where they die of dehydration (fig. 3).



fig 3: Turbine trap assembled outside a barn

Arrangement of the traps

The “Turbine” traps have been assembled along the perimeter of the barns approximately 25m from each other and orientated towards the outside to create a protective barrier between animals and rice fields (fig. 4). The mosquitoes came in large amounts from the rice fields even covering various km, attracted by the dense emission of carbon dioxide produced by the pigs and concentrated in the air by extraction fans positioned on the barn roofs. The extent of attraction for the pigs by the mosquitoes can be demonstrated by the captures obtained after the barn was emptied for slaughtering, which were reduced by at least an order of size, to then return immediately to the values “of regime” on arrival of the new pigs for the fattening cycle.

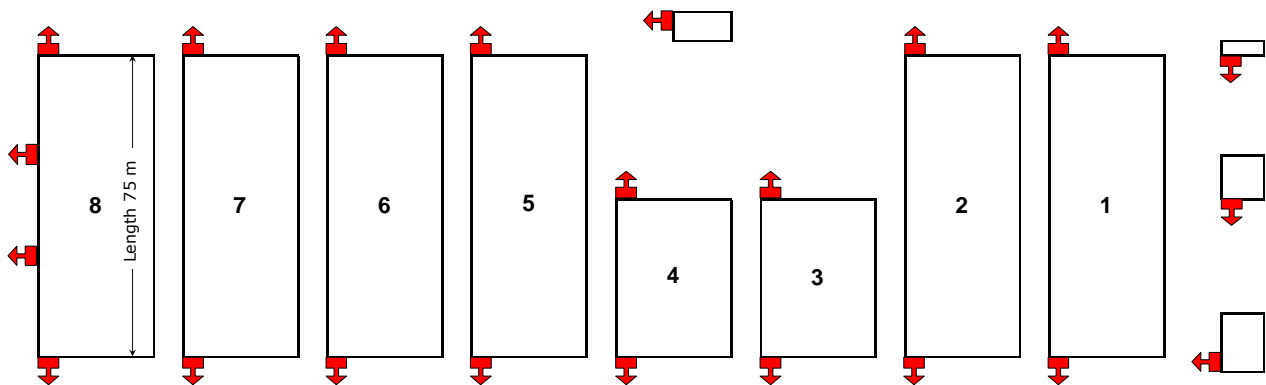


fig. 4: Map of farm n°3 showing the position of the luminous traps and their direction

Weekly collection of the insects, evaluation of the quantity and quality of captures

A multi disciplinary study was started up in this project which involved, in a synergical way, farm managers, competent veterinary surgeons, Mo-EI engineers and the university, with the application of a monitoring protocol which foresaw, as well as the valuation of the captures made by the luminous traps, the positioning of glued paper traps inside the barns and a visual check of the presence of pigs “marked” by mosquito bites. Every activity carried out was documented and special forms were compiled to collect the data and observations made.

The captures made by each luminous trap were quantified, on a weekly basis, by weighing the insects collected and the numeric comparison with the mosquitoes present in each gram was estimated to be on average equal to 400 individuals. Quantitative and qualitative valuation of the presence of mosquitoes inside the barns was carried out in farm n°1, through the use and substitution, on alternate days, of glued paper traps (the use of luminous traps inside is not recommended). A visual check of a sample of 3 specially branded pigs, was carried out in farm n°2 with a weekly collection of photographic documentation which attested the extent of bites and their course in time.

To obtain an evaluation of the results that could be compared to previous years, the farmers were asked to follow the same procedures and the same activities of infestation control as during the previous years.

Results:

Captures obtained using the luminous traps

As one can see from the graph in fig. 5, the data obtained, in general traces the course of the atmospheric temperatures, which point out an exponential growth in captures from the end of May and a progressive reduction towards the end of July, caused by a big disturbance which determined a net reduction of the minimum temperatures.

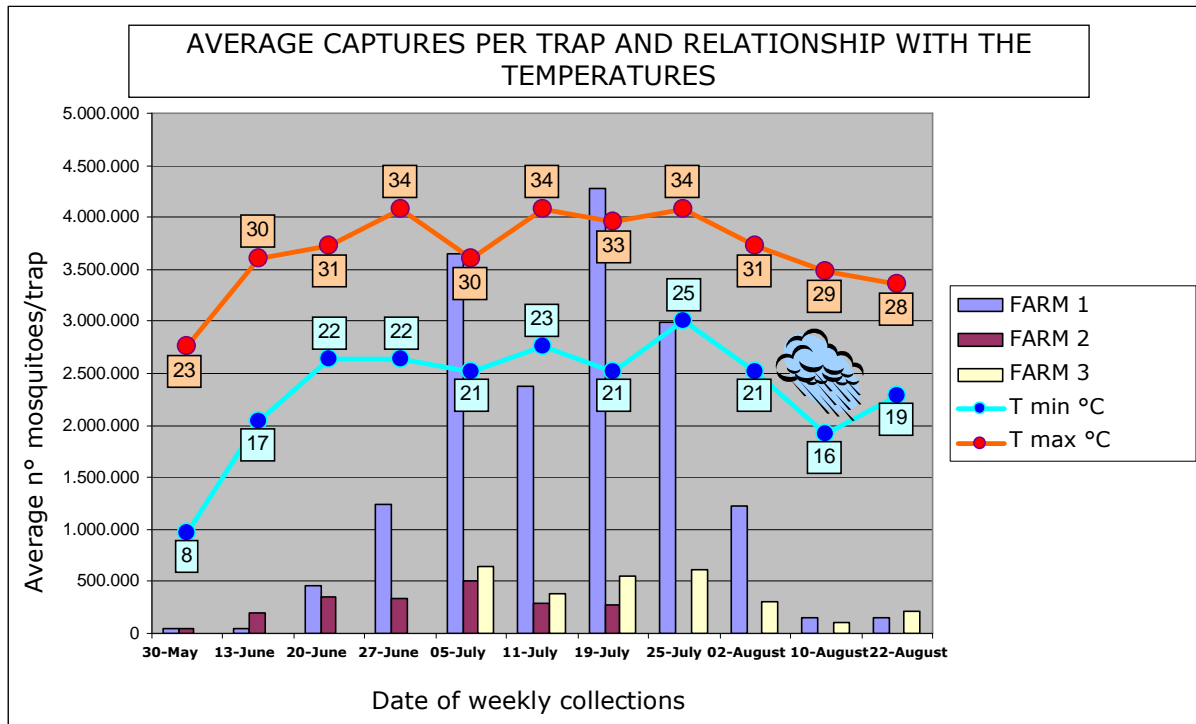


fig. 5: The graph compares the average capture of mosquitoes carried out weekly in the three farms by each trap

From the comparison of the weekly collections of the three farms strike the captures made at farm n°1, in which 116 million individuals were eliminated with a medium capture collecting on average 1.319.795 per trap. In farms n°2 and n°3 the average capture collected was 214.060 and 384.953 mosquitoes per trap (tab. 2).

	N°TURBINE USED	TOTAL MOSQUITOES CAPTURED	N°OF COLLECTIONS CARRIED OUT	AVERAGE CAPTURE PER COLLECTION	AVERAGE CAPTURE PER TRAP PER COLLECTION
Farm n°1	8	116.142.000	11	10.558.364	1.319.795
Farm n°2	20	29.968.400	7	4.281.200	214.060
Farm n°3	22	59.282.800	7	8.468.971	384.953

tab. 2: Total data relating to the capture of mosquitoes carried out by the Turbine aspirating luminous traps

This notable numeric difference shown by the captures carried out in farm n°1 compared to farms n°2 and n°3, denotes the existence of different extent of infestation tied to the distance of the rice fields: in fact farm n°1 is found right next to the rice growing areas, whilst in the other two cases the hotbeds are located a few km away. This also explains why in the first farm the presence of mosquitoes was considerable during all of the day (especially in the shaded areas) and already took on frightening numbers from the first sunset, whilst in the other two farms it became critical only in the evening hours, that is after that time lapse necessary for the mosquitoes coming from further away to reach the barns.

Composition of the captures

From the analysis of the captures made, *Ochlerotatus caspius*, typical mosquito of the rice fields above all in the period between April and July, is the species with the greatest number (60% in farms n°2 and n°3, 75-80% in farm n°1). Type *Culex spp mosquitoes*. represents the remaining portion of captures, with the exception of a small percentage (1-2%) of mosquitoes belonging to the group *Anopheles maculipennis*.

The situation inside the barns and on the pigs

In all the cases the structure of the barns was such as to allow the mosquitoes easy access through the numerous openings found along the sides and on the roofs, as well as for the presence, in farms n°1 and n°2, of outside areas for defecation where the animals often remained.

In general the captures made inside barns with glued paper traps and visual considerations of the pigs used as samples, trace faithfully the trend confirmed by the external luminous traps, that is they grow in size as the infestation evolves.

As far as the consistency and the course in time of the lesions caused by the mosquito bites on the samples of pigs under observation is concerned, change in the itchy red swellings into papule-itchy red swelling lesions to then turn into crusts which heal

usually after 30 days, was noticed. (fig. 7). This course is probably tied to the environment of the pig sty, to the precarious hygienic conditions and to the sensitivity of each single pig.



fig. 6: Turbine trap at the maximum capacity. The bag contained more than 16 Kg of mosquitoes collected in a week.



fig. 7: Appearance of the lesions caused by the mosquito bites on the leg of a pig a few days before slaughtering.

Waste percentage obtained at the slaughterhouse

During trimming operations carried out at slaughtering, the pork legs destined to become ham undergo a rigid selection, where evident imperfections, such as mosquito bites, haematomas and effusions, are a reason for waste and destination for other usage (in these cases 70% of waste is generally caused by the mosquitoes, 20% by haematomas and 10% by effusions).

In the three farms used in the test, cognitive investigations and technical tests were carried out and useful data for a deeper understanding of the problem and for the development of an effective control strategy was collected. Unfortunately, as far as the data regarding the percentage of waste during slaughtering is concerned, the parameters needed to make a detailed comparison with the previous years or with similar situations used as a reference, are available only for farm n°1 (tab. 3), At this farm there was a net reduction of the average percentages of waste compared to the previous year (8.32% against 18.59%) and also compared to a nearby farm with similar characteristics (24% average waste).

FARM N° 1 (COMPARISON OF THE DATA OBTAINED DURING THE PREVIOUS YEAR)			
PERIOD OF SLAUGHTERING	N° OF LEGS SLAUGHTERED	N° OF MARKED LEGS	AVERAGE WASTE %
JUNE 2006	1924	160	8,32
JUNE 2005	4094	761	18,59
SIMILAR FARM NOT INSERTED IN THE CONTROL PROJECT WITH "TURBINE" TRAPS (DATA JUNE 2006)			
JUNE 2006	not obtained	not obtained	24,00

tab. 3: Total data relating to the percentage waste of the legs marked by mosquito bites obtained during pig slaughtering in farm n° 1 and comparison with the previous year. Data kindly supplied by Montorsi of Magreta slaughter house (MO).

The data collected indicates that in June 2006, even without reaching the maximum level, infestation in farm n°1 was already of a high level and the comparisons made with other similar situations make it possible to estimate the potential damages that can be caused.

In farm n°2 slaughter of the pigs ,even if carried out during the period of maximum infestation, gave an average percentage of waste equal to 12,56%. Lastly, in farm n°3 the data is much lower (0,8% legs discarded) since it is connected to, as well as to the capture system prepared, to another two fundamental factors: emptying of the rice fields for rice collection (which determines the fall in the spread of infestations) and closure of the barns with a forced air cooling system (Cooling) activated during the month of August.

This last system however, can only be applied to certain types of barns and is regulated so that it is interrupted during the night hours (when the temperature falls below 23°C) activating the windows which open and allow the mosquitoes to enter momentarily.

Discussion

In conclusion testing carried out in Lomellina pavese, that is, in one of the most critical areas of Italy for the presence of mosquitoes, lays the foundations for the application of a strategy of restriction of infestations by flying insects that can be applied, without structural type distinctions, to all those situations, of emergency and non, in which, for various reasons, it is not possible to intervene in an effective way on the areas of origin of the hotbeds. The enormous volumes of insects captured by the luminous traps are such as to reduce the capacity of the infestations inside the farm or, in general, the areas one wishes to protect, creating an environmental resistance factor proportional to the n° of postings used and to the level of infestation faced. Therefore, the use of such operative strategies can in many cases be of valid help when carrying out insecticide treatments, among other things much more expensive, of environmental impact and effective in the long term.

Thanks

The authors would like to thank dott.sa Giovanna Martelli, researcher of the Dep. Of Veterinary Morphophysiology and Animal production of the Faculty of Veterinary Medicine of the University of Bologna, for suggestions regarding, above all ,the causes of waste of Parma and S. Daniele ham.

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