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Efficacy of Ekomille® in the management of house mouse, *Mus musculus* Linnaeus, in wheat facilities in Southern Italy

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Abstract: *Mus musculus* Linnaeus cause significant direct and indirect damages to wheat. The damages begin already in the field to continue along the food chain. Especially in non-conditioned stored facilities, rodent population density could reach very high levels. In the present study are reported field trials carried out to evaluate a non-toxic system, Ekomille® traps, in rodent management programs. Ekomille® trap is an electromechanical and ecological system for capture of mice and rats. The trap is baited with toxic-free natural foods and it is able to capture over than 80 rodents. We selected a wheat facilities situated in Altamura (Southern Italy), 20 silos, 30.000 tons stored, that presents a very high population of *M. musculus.* Before Ekomille® disposal, deratization was made with rodenticides in many types of formulations. However, has been recognized a large number of sightings of mice, especially under the wheat elevators and have been recorded extensive damages to the electrical systems. From the beginning of June 2011, 20 Ekomille® baited with natural foods (sunflower seeds, pine nuts and pork fat) were placed in the wheat facilities, 4 nearby elevator base, 4 nearby electrical substation, 4 in the second line of defence around silos platform and 8 in the first line of defence along the external perimeter. Traps have been checked weekly during the first month and thereafter every two weeks. From the beginning of June 2011 to the end of May 2012, 354 house mice were captured. After trap use, a drastic reduction of presence of mice and damage caused by rodent activity was observed. These positive results indicate that use of Ekomille® trap for rodents control is a valid component of an IPM-based control strategy. In IPM programs, the employ of these traps can lead to drastic reductions of chemical treatments, resulting in economic benefits and improvements for food safety and quality.

Key words: Ekomille®, house mouse, rodent management, field trial, stored wheat

Introduction

Rodents are an important and ubiquitous group of mammals that occur as indigenous or introduced species throughout the world. The populations of a relatively few species that live in close association with humans, sometimes cause economic damage or become threats to the health of humans or domestic animals (Tobin & Fall, 2004). In particular, commensal rodent species (in Europe: *Mus musculus domesticus* complex, *Rattus rattus* (Linnaeus) and *Rattus norvegicus* Berkenhout) have lived together with humans for millennia, and their high reproduction rates and omnivory, can lead to significant impacts (Meehan, 1984) by consuming or fouling stored products, acting as disease vectors or destroying infrastructure. Therefore it has always been necessary to initiate actions for management of rodent infestations.

The fighting systems used to monitor the rodents have been numerous. However, since the 1950s, anticoagulants have been the most widely used rodenticides (Meehan, 1984). Second generation anticoagulant rodenticides (SGARs), such as brodifacoum, bromadiolone, difenacoum, and difethialone, were developed during the 1970s and are much more toxic than

first generation anticoagulant rodenticides, usually requiring only a single ingestion by commensal rodents to be a lethal dose.

However, SGARs have considerable problems. Genetic resistance to anticoagulant rodenticides emerged as early as 1958 and continues to be a concern with second generation anticoagulants (Boyle, 1960; Martin *et al.*, 1979; Lund, 1984; MacNicoll & Gill, 1987; Buckle, 1994; Buckle *et al.*, 1994; Greaves, 1994; Kerins *et al*., 2001; Lodal, 2001; Pelz *et al.*, 1995 and 2005; Pelz, 2001; Rost *et al.*, 2004; Buckle, 2006; Prescott *et al.*, 2011; Baert *et al.*, 2012; Meerburg, 2014).

Exposure of non-target animals to anticoagulant rodenticides (ARs), however, can occur by direct bait intake (primary exposure) or when residues of ARs are passed through the food chain via prey and carrion (secondary exposure). SGARs have a higher toxicity to vertebrates and persist longer in animal tissue than first generation anticoagulant rodenticides (Eason *et al*., 2002; Fisher *et al*., 2003). Predators are at great risk of secondary poisoning because the persistent ARs accumulate in the liver (Eason *et al*., 2002). There is worldwide evidence of secondary exposure to SGARs in aerial and terrestrial predators (Berny *et al*., 1997; McDonald *et al*., 1998; Eason *et al*., 2002; Fisher *et al.*, 2003; Raoul *et al*., 2003; Brakes & Smith, 2005; Spurr *et al*., 2005; Riley *et al*., 2007; Dowding *et al*., 2010; Laakso *et al*., 2010; Thomas *et al.*, 2011; Christensen *et al*., 2012; Gabriel *et al*., 2012; Brooke *et al.*, 2013; Langford *et al.*, 2013; Geduhn *et al*., 2014, Elliott *et al*., 2014; Lopez-Perea *et al.*, 2015).

Another problem is the dispersion possibility of rodenticide bait from the security dispenser for accidental or intentional causes. Another problem associated with the use of rodenticides is the impossibility of knowing where rodents are going to die, resulting in a dispersion of poisoned carcasses into the environment.

As a result of gradual introduction of Biocide Regulation (UE 528/2012), and through the application of measures for risk mitigation, will have a drastic reduction of the use of rodenticides. Therefore it will be increasingly necessary to use valid alternative to rodenticides to manage populations of synanthropic rodents.

In the present study are reported field trials carried out to evaluate a non-toxic system, Ekomille® traps (Ekommerce Srl, Atessa, Italy), in the management of *M. musculus* in a wheat facilities in Southern Italy. This trap is also used for the control of the other two synanthropic rodents, *Rattus norvegicus* and *Rattus rattus* (D'Intino *et al.*, 2012; Spina, 2014).

Material and methods

The tests were carried out in a durum wheat facilities in Altamura (BA) in Southern Italy (Figure 1). The deposit was chosen because it has structural defects that make it particularly prone to infestations of synanthropic rodents. The storage system is very short, for that reason it is not possible to make fumigation with toxic gases.

The deposit consists of two batteries of 10 silos each. Each silo has a capacity of 1,500 tons of corn, for a total of 30,000 tons. Unlike the most of storage facilities for cereal which have conveyors inserted in a tunnel viable by operators to guarantee the operations of cleaning and maintenance, in this case the conveyors are placed inside a small tunnel, with dimensions 60 x 60 cm, directly under the silos. The system of rodent control used in the facility it has always been of chemical type, with the use of large quantities of anticoagulant rodenticides in the most different formulations. The high infestation, caused a very big problem to the electrical system, heavily damaged by that rodent activities and with consequent and repeated block to the structure. Starting from June 2011 were placed 20 Ekomille traps.

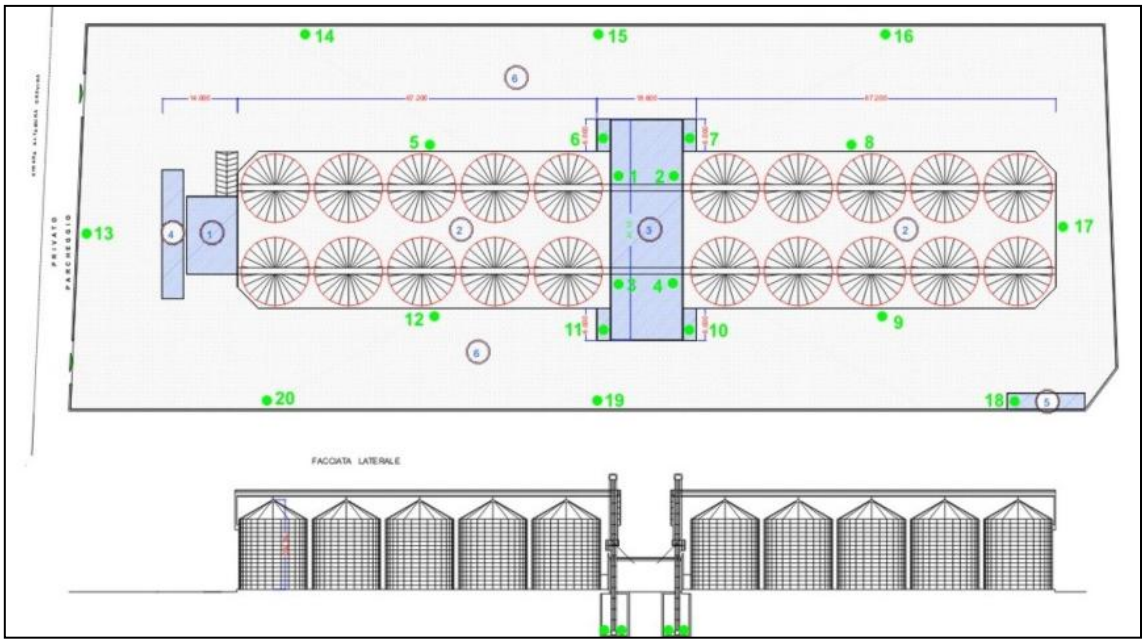

Figure 1. Layout of wheat facilities and position of Ekomille.

Figure 2. Posterior part of Ekomille.

Ekomille (Figure 2) is an electromechanical trap able to catch over 80 rodents. It is composed by two parts. In the upper section are located all the mechanical components, manger and natural baits. In the lower section there is a collector bucket. Ekomille is baited

with only natural and non-toxic food, into 16 bait compartments all around the traps, starting from the stair. The phase of capture begins when the animal tries to eat in the main manger. The sensor is situated just next to the manger and is activated as soon as the animal touches it. The animal is captured and isolated from the outside into the collector bucket.

Four Ekomille were disposed at the base of the lifts, 4 near electrical switchboards, 4 in the second line of defense around the deck of the silos and 8 in the first line of defense along the external perimeter of the establishment.

Initially Ekomille were baited with sunflower seeds, pork fat and pine nuts. After two weeks has been added, which supplementary lure, the herring meal in all equipment.

The control of Ekomille occurred every two weeks.

Throughout treatment there was not performed structural maintenance. In the first week of February 2012 it was carried out within the base of the elevators, a clean-extraordinary to reduce competition for food.

Results and discussion

From beginning of June 2011 to the end of May 2012 were captured 354 specimens of *M. musculus.*

Inside the elevator base have been trapped 206 *Mus*, near the electrical substations 133 and 15 into the Ekomille placed in the outer perimeter of the first line of defense. The machines placed in the second line of defense instead have never shown of the catch.

Figure 3 shows the trend of the catches of rodents positioned by Ekomille arranged in the elevators base during the first two weeks of the relocation of the traps, in which the baits were only sunflower seeds, pork fat and pine nuts, no catches were recorded. Following the addition of herring meal inside the machine we started to have the catch.

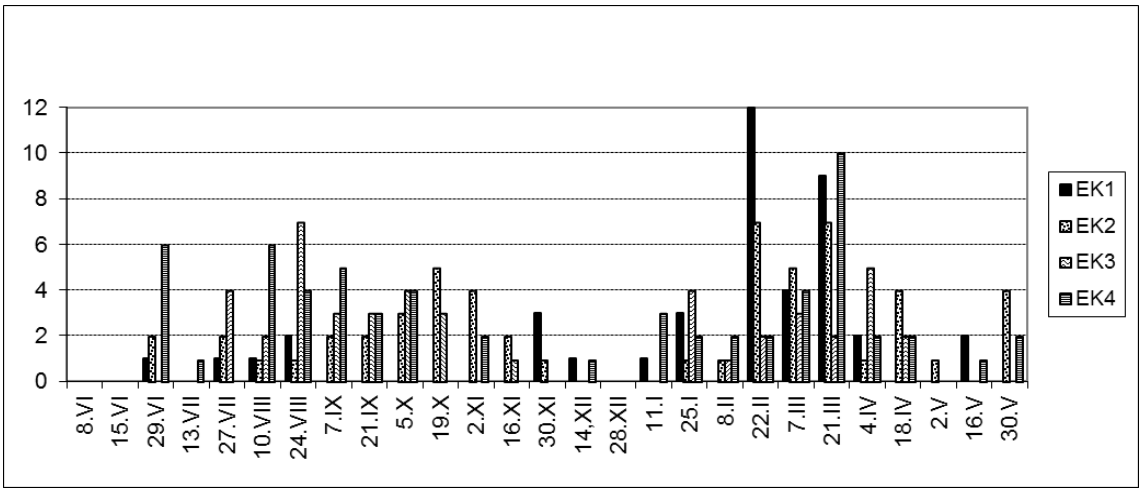

Figure 3. Mice trapped in the Ekomille placed in the elevators base.

The number of mice trapped was growing until August 24 (14 *M. musculus* captured) then fall steadily until December 28.

Following to reduce the strong competition for present food into the environment, was made an extraordinary operation of cleaning at the base of the elevators with collection of a large amount of wheat in the base of the elevators. Later was observed a new increase of captures with a peak of 28 mice on March 21, and then decreasing again.

Figure 4 shows the data for catches of mice carried out by Ekomille disposed closed the electric cabins. The trend is similar to that recorded catches at the base of the elevators by the traps. Also in this case, during the first two weeks of treatment no captures was made, after the baiting with herring meal have started to record catches.

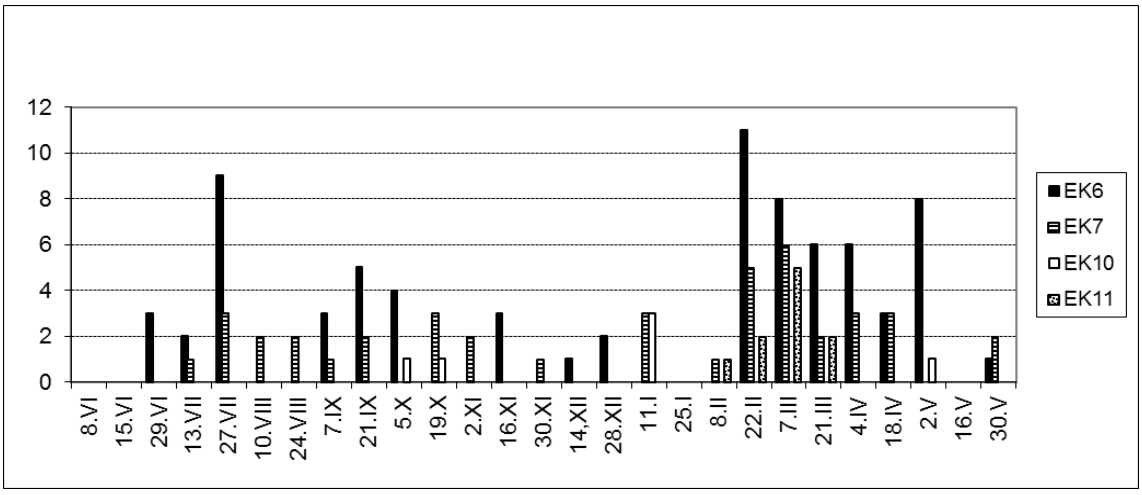

Figure 4. Mice trapped in the Ekomille placed nearby the electrical substations.

The first peak of catches has had on July 27 (12 *M. musculus* captured), and then observed a decline of the specimens trapped. Following the extraordinary intervention of cleaning performed on elevators, it has been registered a rapid increase in catches with a peak recorded on March 7 (19 *M. musculus* captured).

Machines positioned in the second line of defense (Ekomille 5, 8, 9 and 12) have never captured rodents.

Figure 5 shows the trend of rodent capture made by Ekomille disposed in the outer perimeter of the plant along the first line of defense. The catches in this case have always been occasional and discontinuous with a maximum number of specimens caught for machine biweekly never exceed two.

The capture data have highlighted endemic infestation of the plant due to high critical structural factors that allow the development and proliferation of a large population of rodents.

At the light of the above, it was not possible to obtain eradication of the infestation of *M. musculus*. However, even though the deposit had serious structural deficiencies, the results were encouraging. In fact, after the disposal of the Ekomille the population of mice was reduced to a level such that have not been registered most damage to the structure and have not suffered other production stops.

With this system we completely deleted the risk of contamination by rodenticides, and of SGARs bait dispersion. Another positive result is that we completely removed the risk of poisoning of non-target animals and deleted the dispersion of poisoned carcasses into the environment.

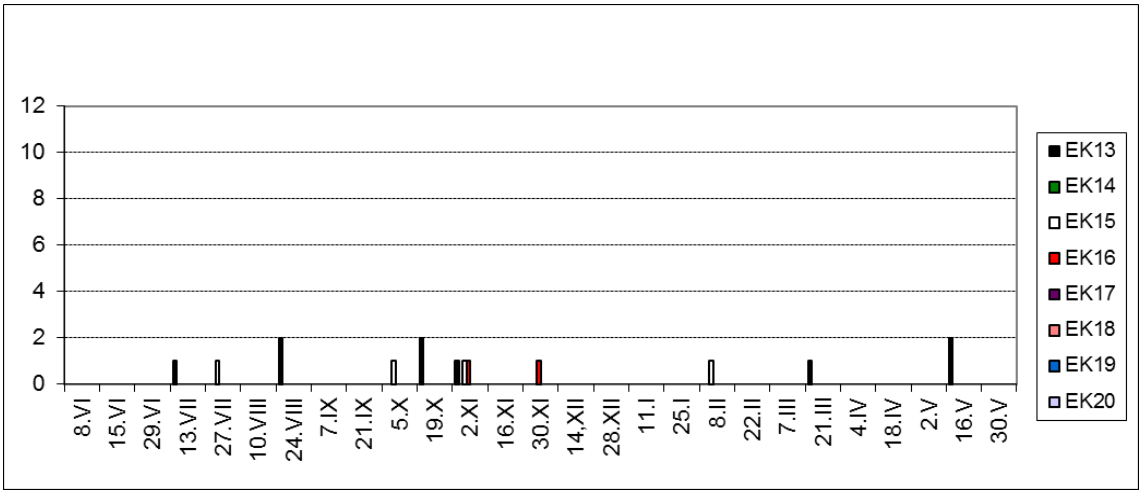

Figure 5. Mice trapped in the Ekomille placed in the first line of defence.

However, to ensure good and lasting results would be important include the capture systems in a more organic approach to IPM. It follows that before they assume direct control systems, it should take action on the environment and structures.

Good activities of sanitation and proper structural planning are the foundation of valid successful plans of IPM (Trematerra & Fleurat-Lessard, 2015).

The positive results obtained with the use of Ekomille® trap for rodents control indicated that is a valid component of an IPM-based control strategy. In IPM programs, the employ of these traps can lead to drastic reductions of chemical treatments, resulting in economic benefits and improvements for food safety and quality.

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