# MONITORING OF STORAGE INSECTS IN NORTHEAST MEXICO BY FOOD PACKETS AND PHEROMONE TRAPS

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ABSTRACT: Three trap desings were placed in farms of northeast Mexico and renewed every one or two months for arround 14 months: a sticky wing trap and a corrugated cardboard trap with 50 µl of a P. truncatus pheromone and a food packet with a mixture of grains. Additionally, a food packet was placed in the farms for two periods of six to eight months. The trapping sites were outside the facilities not used to store grain.

The food packets were most efficient for capturing Coleoptera adults, but Lepidoptera larvae were also collected. Forty seven species were registered: 40 Coleoptera and seven Lepidoptera. Additionally, Psocoptera, Thysanura, Hymenoptera, Embioptera, and Acarina were collected, but identification was not attempted. R. dominica and S. zeamais were the most abundant Coleoptera. Other very common species were: L. serricorne, T. confusus, T. castaneum, C. pusillus, Carpophilus spp. and S. cerealella. In many species, the catch decreased from December to March and peaked sometime from June to August, coinciding with the periods when maize is mature in the field.

The corrugated carboard traps never captured a Bostrichidae. The wing traps captured only one P. truncatus in the autumn and several R. dominica throughout the year, with a population increase that started in April.

INTRODUCTION: Many insect species infest stored products in Mexico, but the are few studies on their distribution and abundance. In Northeast Mexico, the information on this subject was scarce. Flores Vega (1977) made lists of stored product insect species present in Mexico. He listed 27 insect species and one mite of national distribution and one additional insect species for the northeast. Gutiérrez Díaz and Jiménez Sánchez (1989) reported the species present in 203 grain samples from many localities of Mexico. Only two samples were from the northeast and only four species were found.

Studies from the author's research project have also included the identification of insect species in samples taken in farms from northeast Mexico. Fifteen stored-product insect species were found in corncobs before harvest in 48 localities. Also, 15 species were present in maize stored traditionally until consumption in 29 farms (3 to 8 months); Palorus subdepresus was present before harvest but absent in storage, and the contrary happend with Ahasverus advena. Therefore, 16 species were reported as a total. (Aguilar Olague et al., 1988; Rodríguez Hernández, 1988).

The objective of this study was to detect stored-product insect species in the rural area of northeast Mexico and to determine their distribution and relative abundance through the use of food packets and traps baited with a pheromone of the larger grain borer, Prostephanus truncatus (Horn).

MATERIALS AND METHODS: The food packet was similar to the one recomended by Strong (1970). It contained a mixture of one part each, by weight of whole corn, wheat, sorghum and beans, cracked corn, rolled oats and poultry laying mash. A packet consisted of 100 g of the mixture wraped on cheesecloth and covered with a 7 mm mesh hardware cloth for protection from birds and rodents. The mixture was fumigated and stored free of infestations in a metal drum until it was used.

Two trap designs, baited with 50 µl of a synthetic pheromone of P. truncatus in a polyethylene vial were used to capture this species and R. dominica (Guardado Ureña. 1988; Guardado Ureña and Leos-Martínez, 1989). This pheromone corresponds to the one named Trunc-call I (Hodges et al., 1984) and was provided by Dr. Howard J. Williams from Texas A&M University. One of the trap designs was a cardboard crevice trap (Burkholder, 1976; Hodges, 1986) treated with insecticide and the other was an adhesive wing trap (Leos-Martínez, 1990). Both trap designs were built locally.

The study was developed in a zone located between 25°30' and 26°40' NL and 97°45' and 100°10' WL in northeast Mexico. This regions is generally cold from December to February and warm the rest of the year; annual rainfall is arround 500-600 mm in most places. The trapping zone consisted of two contrasting areas. One is the northeast of the state of Nuevo Leon, where agriculture is not common and farms are used mainly for animal production. The other is the northern of the state of Tamaulipas, where a large part of the maize and sorghum consumed in Mexico is produced, with developed technology.

Ninety seven farms and rural houses were selected as trapping sites: 44 in Nuevo Leon and 53 in Tamaulipas (Fig. 1). In each site, two food packets were separately placed: one was renewed every 30 to 55 days from March, 1986 (April in Tamaulipas) to July, 1987 and the other was exposed from June to November, 1986 and then changed for one that remained exposed until July, 1987. Additionally, in five of the sites of Nuevo Leon and 19 of Tamaulipas, one corrugated cardboard trap and one wing trap, baited with pheromone, were separately located and renewed every 36 to 63 days for one year.

The traps were placed outside rural facilities not specifically used to store grain; for example: the house of the farmer's family, sheds for goats, sheeps or horses, poultry facilities, garages and equipment shelters. The food packets were placed in contact to outside walls and eaves, so they work as surface traps capturing both flying and walking insects. The wing traps were simply hung as aerial traps. In both cases, traps were protected from the rain and placed 2 to 3 m above the ground to avoid damage from animals and people. The corrugated cardboard traps were located on the floor or on top of flat structures up to 3 m above the ground. After the exposure, the traps were collected individually in plastic bags and taken to the laboratory, where they were held at 10°C until the adult insect were separated by species in vials with 70% alcohol. Damaged traps were eliminated from the counts.

Species identification was made with taxonomic keys and by comparison with specimens in reference collections. Antonio E. Marín from the Instituto Nacional de Investigaciones Forestales y Agropecuarias of Mexico (INIFAP-SARH) and J.M. Kingsolver from the Systematic Entomology Laboratory, (PSEI, USDA) confirmed and identified some of the confusing species.

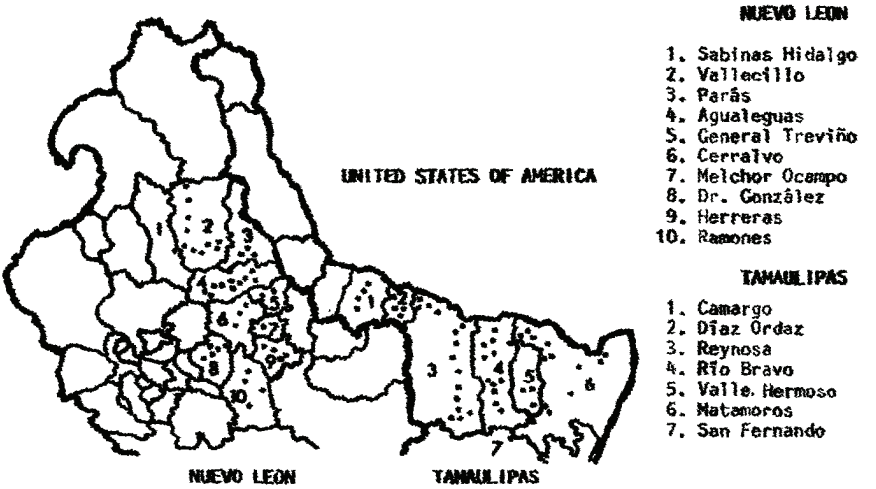


Fig. 1. Trapping sites in northeast Mexico.

RESULTS: Food packets. This method was more efficient for capturing Coleoptera adults, but Lepidoptera larvae were also collected. Forty seven species were registred: 40 Coleoptera and seven Lepidoptera (Table I). Aditionally, Psocoptera, Thysanura, Hymenoptera, Embioptera and Acarina were collected, but their identification was not attempted.

Thirteen species registered in Tamaulipas were not detected in Nuevo Leon: P. truncatus, A. cornutus, Xilobiops sp., T. tabaci, Alphitobius sp., G. maxillosus, A. bifasciatus, Lobometopon sp., O. mercartor, a Mycetophagidae not identified, Cryptophagus sp., M. ovalis and A. fasciculatus. Similarly, three species found in Nuevo Leon were not detected in Tamaulipas: L. oryzae, P. subdepresus and a Histeridae not identified.

Table I presents the condensed data of the packets exposed for periods 6-8 months long. In Nuevo Leon, food packets of 36 trapping sites were considered valid for the first exposure period and 38 for the second; the rest were damaged or missing. In Tamaulipas, 47 and 50 packets were accepted for the first and second periods, respectively.

Table II shows the adult insects collected in the packets exposed for periods 30 to 55 days long. A total of 462 and 459 packets were considered valid in Nuevo Leon and Tamaulipas, respectively.

The most abundant and widespread Coleoptera was Rhyzopertha dominica. It was collected in large numbers; it was present in all the trapping sites of Tamaulipas, 95.5% of the sites of Nuevo Leon and arround 50% of the packets.

Sitophilus zeamais was not so numerous, but it was well distributed in the region. This can be said because in the second long exposure period, Sitophilus was counted by species. In this period, 244 adults of S. zeamais and 76.3% infested packets were counted in Nuevo Leon; for S. oryzae the counts were of only 17

Table I. Coleoptera and Lepidoptera species collected in food packets in northeast Mexico and data about abundance and distribution according to the capture of the packets exposed several months.

| Insects | | Nuevo León | | | Tamaulipas | | |
|---|---|---|---|---|---|---|---|
| | | | Adults collected | Infested packets (%) | | Adults collected | Infested packets (%) |
| **COLEOPTERA** | | | | | | | |
| Curculionidae | Sitophilus zeamais | Both | | | Both | | |
| | Sitophilus oryzae | spp. | 353 | 54.0 | spp. | 1,046 | 59.8 1/ |
| Bostrichidae | Rhyzopertha dominica | | 3,626 | 59.4 | | 8,489 | 61.9 |
| | Prostephanus truncatus | | 0 | 0.0 | | 0 | 0.0 2/ |
| | Amphicerus cornutus | | 0 | 0.0 | | 4 | 1.0 |
| | Xilobiops sp. | | 0 | 0.0 | | 1 | 1.0 |
| Anobiidae | Lasioderma serricorne | | 3,404 | 44.5 | | 102 | 9.3 |
| | Stegobium paniceum | | 11 | 1.3 | | 0 | 0.0 |
| | Tricorynus confusus | | 461 | 50.0 | | 173 | 24.7 |
| | Tricorynus tabaci | | 0 | 0.0 | | 6 | 1.0 |
| Tenebrionidae | Tribolium castaneum | | 463 | 27.0 | | 186 | 21.6 |
| | Latheticus oryzae | | 369 | 1.3 | | 0 | 0.0 |
| | Alphitobius sp. | | 0 | 0.0 | | 0 | 0.0 2/ |
| | Gnatocerus maxillosus | | 0 | 0.0 | | 5 | 1.0 |
| | Alphitophagus bifasciatus | | 0 | 0.0 | | 0 | 0.0 2/ |
| | Palorus subdepresus | | 0 | 0.0 | | 0 | 0.0 |
| | Lobometopon sp. | | 0 | 0.0 | | 0 | 0.0 2/ |
| Nitidulidae | Carpophilus dimidiatus | | | | | | |
| | Carpophilus pilosellus | All | | | All | | |
| | Carpophilus obsoletus | spp. | 389 | 6.7 | spp. | 1,116 | 24.7 3/ |
| Cucujidae | Cryptolestes pusillus | Both | | | Both | | |
| | Cryptolestes ferrugineus | spp. | 437 | 17.5 | spp. | 406 | 16.5 4/ |
| | Carthartus quadricollis | | 0 | 0.0 | | 160 | 8.2 |
| Silvanidae | Oryzaephilus surinamensis | | 176 | 6.7 | | 1 | 1.0 |
| | Oryzaephilus mercartor | | 0 | 0.0 | | 0 | 0.0 2/ |
| | Ahasverus advena | | 1 | 1.3 | | 0 | 0.0 |
| Lyctidae | Trogoxylon aequale | | 121 | 12.1 | | 23 | 3.1 |
| Dermestidae | Trogoderma inclusum | | 36 | 12.1 | | 1 | 1.0 |
| Mycetophagidae | Typhaea stercorea | | 0 | 0.0 | | 0 | 0.0 2/ |
| | sp. not identified | | 0 | 0.0 | | 0 | 0.0 2/ |
| Cryptophagidae | Cryptophagus sp. | | 0 | 0.0 | | 0 | 0.0 2/ |
| Rhyzophagidae | Smicrips sp. | | 0 | 0.0 | | 0 | 0.0 2/ |
| Cerylonidae | Murmidus ovalis | | 0 | 0.0 | | 0 | 0.0 2/ |
| Anthribidae | Araecerus fasciculatus | | 0 | 0.0 | | 0 | 0.0 2/ |
| Anthicidae | Anthicus sp. | | 1 | 1.3 | | 0 | 0.0 |
| Lathridiidae | sp. not identified | | 0 | 0.0 | | 1 | 1.0 |
| Histeridae | sp. not identified | | 1 | 1.3 | | 0 | 0.0 |
| Scolytidae | sp. not identified | | 0 | 0.0 | | 9 | 1.0 |
| Derodontidae | sp. not identified | | 0 | 0.0 | | 0 | 0.0 2/ |
| Bruchidae | Acanthoscelides obtectus | | 1 | 1.3 | | 1 | 1.0 |
| **LEPIDOPTERA** | | | | | | | 5/ |
| Gelechiidae | Sitotroga cerealella | | 0 | 0.0 | | 4 | 1.0 |
| Pyralidae | Corcyra cephalonica | | 0 | 0.0 | | 0 | 0.0 |
| | Cadra cautella | | 0 | 0.0 | | 0 | 0.0 |
| | Plodia interpunctella | | 0 | 0.0 | | 0 | 0.0 |
| | Ephestia elutella | | 0 | 0.0 | | 0 | 0.0 |
| Cosmopterigidae | Pyroderces rileyi | | 0 | 0.0 | | 0 | 0.0 |
| Tineidae | Memapogon granella | | 0 | 0.0 | | 0 | 0.0 |

1/ Only in the second trapping period Sitophilus was counted by species.
2/ Collected only in the food packets exposed in periods 30-55 days long.
3/ Counted as Carpophilus spp. and identified later on.
4/ Only in the first trapping period Cryptolestes was counted by species.
5/ Most Lepidoptera were collected as larvae in packets exposed for 30-55 days.

Table II. Adult Coleptera and Lepidoptera collected in the food packets exposed for periods 30-55 days long.

| Insects | Nuevo León | | | Tamaulipas | | |
|---|---|---|---|---|---|---|
| | Adults collected | Infested packets (%) | Infested sites (%) | Adults collected | Infested packets (%) | Infested sites (%) |
| **COLEOPTERA** | | | | | | |
| Sitophilus spp. | 613 | 44.2 | 100.0 | 1,138 | 62.5 | 100.0 |
| R. dominica | 3,638 | 33.3 | 95.5 | 5,411 | 51.2 | 100.0 |
| P. truncatus | 0 | 0.0 | 0.0 | 1 | 0.2 | 1.8 |
| L. serricorne | 740 | 10.0 | 52.2 | 272 | 8.5 | 62.2 |
| S. paniceum | 10 | 0.2 | 2.2 | 2 | 0.4 | 3.7 |
| T. confusus | 603 | 6.7 | 63.6 | 115 | 5.7 | 37.7 |
| T. castaneum | 380 | 16.7 | 86.3 | 200 | 12.0 | 62.2 |
| L. oryzae | 475 | 0.9 | 6.8 | 0 | 0.0 | 0.0 |
| Alphitobius sp. | 0 | 0.0 | 0.0 | 35 | 3.7 | 28.3 |
| G. maxillosus | 0 | 0.0 | 0.0 | 1 | 0.2 | 1.8 |
| A. bifasciatus | 0 | 0.0 | 0.0 | 2 | 0.2 | 3.7 |
| P. subdepresus | 3 | 0.6 | 6.8 | 0 | 0.0 | 0.0 |
| Lobometopon sp. | 0 | 0.0 | 0.0 | 1 | 0.2 | 1.8 |
| Carpophilus spp. | 254 | 3.2 | 29.5 | 2,609 | 21.1 | 69.8 |
| Cryptolestes spp. | 168 | 12.3 | 68.1 | 393 | 16.3 | 77.3 |
| C. quadricollis | 8 | 1.5 | 13.6 | 381 | 5.4 | 37.7 |
| Oryzaephilus spp. | 22 | 3.2 | 27.2 | 127 | 2.4 | 16.9 |
| A. advena | 25 | 1.9 | 20.4 | 55 | 2.6 | 30.1 |
| T. aequale | 526 | 11.3 | 54.5 | 183 | 3.5 | 16.9 |
| T. inclusum | 12 | 1.5 | 13.6 | 1 | 0.2 | 1.8 |
| T. stercorea | 1 | 0.2 | 2.2 | 30 | 1.1 | 7.5 |
| Mycetophagidae indet | 0 | 0.0 | 0.0 | 1 | 0.2 | 1.8 |
| Cryptophagus sp. | 0 | 0.0 | 0.0 | 29 | 2.6 | 18.8 |
| Smicrips sp. | 0 | 0.0 | 0.0 | 32 | 3.1 | 20.7 |
| M. ovalis | 0 | 0.0 | 0.0 | 1 | 0.2 | 1.8 |
| A. fasciculatus | 0 | 0.0 | 0.0 | 5 | 0.2 | 1.8 |
| Anthicus | 0 | 0.0 | 0.0 | 1 | 0.2 | 1.8 |
| Lathridiidae indet. | 6 | 0.6 | 4.5 | 20 | 1.7 | 13.2 |
| Scolytidae indet. | 1 | 0.2 | 2.2 | 8 | 1.1 | 7.5 |
| Derodontidae indet. | 6 | 1.1 | 9.0 | 21 | 1.3 | 11.3 |
| A. obtectus | 3 | 0.6 | 6.8 | 0 | 0.0 | 0.0 |
| **LEPIDOPTERA** | | | | | | |
| S. cerealella | 2 | 0.4 | 4.5 | 25 | 2.2 | 15.0 |

adults and 26.3% infested packets. In Tamaulipas, the numbers were 455 adults and 62% infested packets for S. zeamais, and 63 adults and 26% infested packets for S. oryzae. Considering both species, this genus was in 100% of the sites.

Other very common insects were L. serricorne, T. confusus, T. castaneum, Carpophilus spp. and C. pusillus. This last species was counted separately from C. ferrugineus only in the first long exposure period. In Nuevo Leon, the catch was 269 C. pusillus and one C. ferrugineus with 22.2 and 2.7% infested packets, respectively. In Tamaulipas, 192 C. pusillus and 22 C. ferrugineus were captured in this period, with 6.4% infested packets by any of the species.

From the lepidopterans, only S. cerealella and N. granella were collected as adults, the rest of the species were collected as larvae. To obtain information on the relative abundance of Lepidoptera species, the larvae were identified and counted in 225 packets exposed for periods 30 to 55 days long (27 May to 25 November, 1986) in northern Tamaulipas. The data about the number of larvae and the percentage of infested packets, respectively for each species were: C. cephalonica 48 and 0.8%, P. rieleyi 28 and 4.0%, C. cautella 18 and 4.4%, P. interpunctella 16 and 2.2%, and E. elutella 11 and 2.2%.

The number of insects collected in the packets exposed 30 to 55 days, was used to make Figure 2. In most cases, captures were lower in 1986 than in 1987, probably because of the drought of that year, a catch reduction was evident during the cold months (December to February) and peak captures of several species coincided with the postmaturity-preharvest period of maize.

Pheromone traps: The corrugated cardboard trap was inefficient for the objetive of this study. No Bostrichidae was captured by this method. Although no attractant was used for Sitophilus spp., 15 adults were found in three of the 192 traps used in the study. Additionally, a few field beetles and spiders were captured.

The adhesive wing trap did capture bostrichids. Only one P. truncatus was trapped in the November-December trapping period at a rural house in Nuevo Leon, and several R. dominica in all the sites throughout the year.

Capture was rather low in 1986 with less than 0.03 insects/trap/day, but a population increase started in April, 1987 and remained high until the end of the study, in July. Because of one extraordinarily infested site, Nuevo Leon had a mean final count of 4.3 insects/trap/day, whereas in Tamaulipas the mean was 0.18. However, in general, captures were larger in Tamaulipas than in Nuevo Leon, particularly in the grain producing area of Reynosa and Río Bravo.

DISCUSION AND CONCLUSIONS: Food packets detected more species than the method of taking samples of grain, used previously in my laboratory. Furthermore, 31 species had not been listed by Flores Vega (1977) as present in northeast Mexico. On the other hand, eight species in the list of insects with national distribution and one in the list for the northeast were not detected by the food packets. These species are: Sitophilus granarius, Tribolium confusum, Gnatocerus cornutus, Tenebrio obscurus, Tenebrio molitor, Paraxonotha kirschi, Zabrotes subfasciatus, Anagasta kuehniella and Europhryum confine. The presence of Z. subfasciatus and T. confusum in the region, has been acknowledged in my laboratory a few times. However, for the rest of the species there has been no report of confirma-

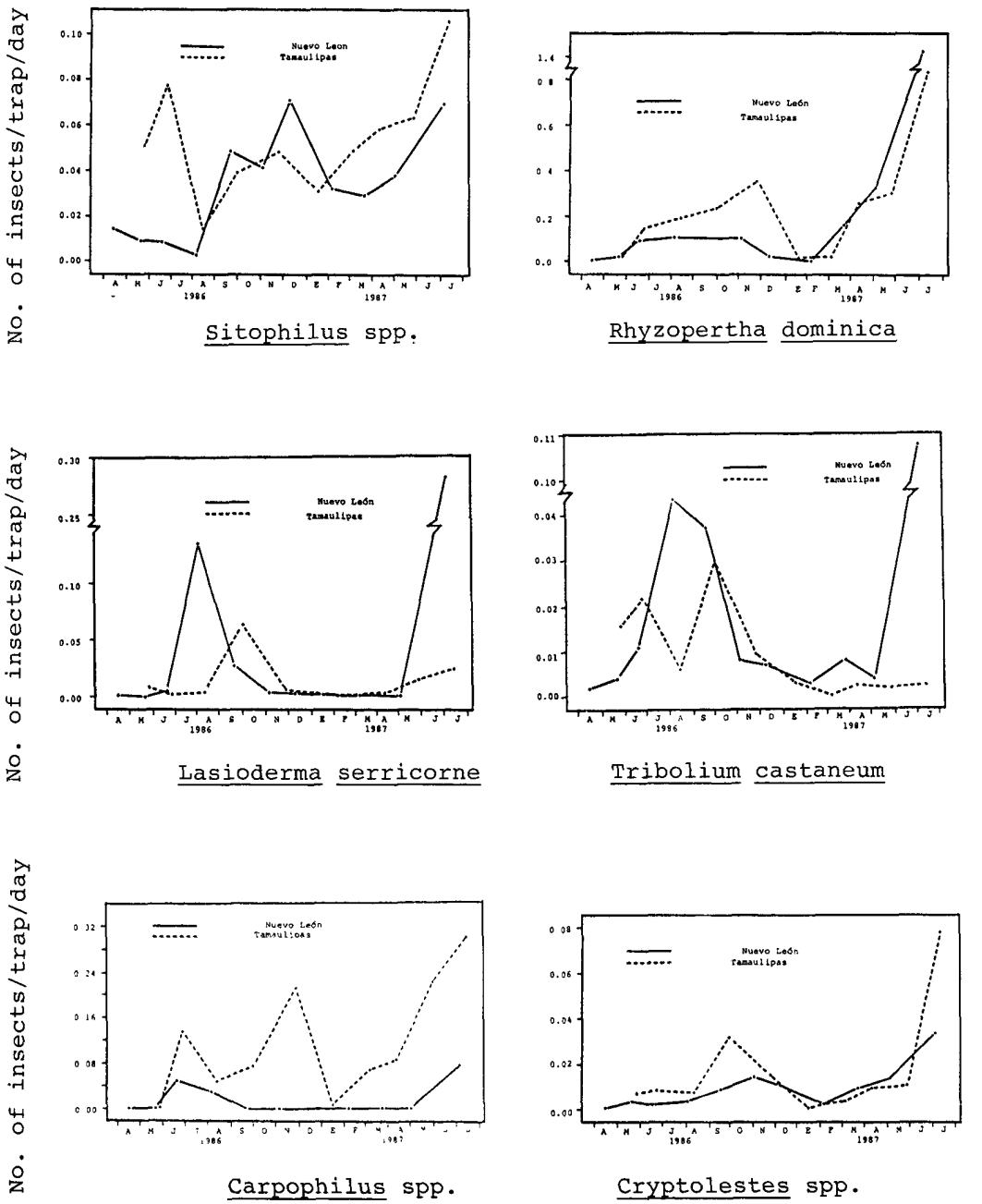


Fig. 2. Adults captured in food packets exposed for period of 30 to 55 days in northeast Mexico.

tion. If they are in the area, it must be in very low population density or in conditions different to the ones considered here. They were not detected in the grain samplings from farms in the region either (Aguilar Olague et al., 1988). Curiously, many people in Mexico believe mistakenly, because of academic traditions, that S. granarius, T. confusum and T. molitor are abundant in northeast Mexico.

Species that are not in the list of Flores Vega (1977) nor were detected in the present study, but that had been collected in the region and identified in my laboratory are: Tenebroides mauritanicus, Carpophilus hemipterus, Attagenus (=megatoma= piceus) unicolor, Gibbium psylloides and Callosobruchus maculatus. All these species have hosts and feeding behaviors that make them difficult to be attracted by the food mixture used here. Packets with other food combination are recommended.

No explanation can be given to the findings of more insect species in Tamaulipas than in Nuevo Leon; however, it is apparent that the variation on climate and vegetation and the state of development of agriculture and storage in Tamaulipas played an important role. Again, the species may be present, but in population densities below the level that is perceptible through the use of food packets.

When food packets are exposed longer than the life cicle of insects, new adults are produced inside of them. Therefore, the number of adults in a packet is determined by the interaction between the abundance of insects in the area and the climate that afect the development of the population in the packet. This type of trapping is not appropiate to estimate the population fluctuations or at least the results are difficult to interpret (Leos-Martinez, 1984). Nevertheless, if the main objetive of a study is to detect as many species as posible in a qualitative survery this method is probably the most inexpensive and efficient one.

The author found that food packets exposed for no more than two months, gave a good estimation of the relative abundance of insects; however, it was also pointed out that since insects can leave the packets, specially in extreme cold or hot weather the data should be taken cautiously (Leos-Martinez, 1984). I believe that even with this limitation, the fluctuations shown in Fig. 2 represent, for the most part, changes in insect population density.

The pheromone traps were not as efficient as expected. The corrugated cardboard trap is probably appropiate only if it is placed near the infested commodity, as is generally recommended. In this study, the methodology called for locating the traps in places not used to store grain. This was one of the reason for the zero captures. The wing traps gave some data on abundance, distribution and pupulation fluctuation of R. dominica, but capture was larger in the food packets.

The capture of only one P. truncatus in the adhesive pheromone trap corroborated the very low population densities suggested by the capture in the food packets and by previous research (Aguilar olague, et al., 1988). Nevertheless, this type of results are not satisfactory: The use of the newly developed Truncall pheromone is recommended for future works.

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# LA SURVEILLANCE DES INSECTES DES STOCKS DANS LE NORD-EST DU MEXIQUE PAR SACHETS-PIEGES ALIMENTAIRES ET PIEGES A PHEROMONE

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## Résumé

Quatre-vingt-dix-sept fermes ont été choisies dans une zone située entre 25°30' et 26°40' de latitude nord; et 97°45' et 100°10' de longitude ouest dans le nord-est du Mexique. Dans chaque ferme, trois sortes de pièges ont été placés et renouvelés tous les 35 à 55 jours pendant 14 mois environ : un sachet-piège alimentaire rempli d'un mélange de grains, un piège à plaquette engluée et un piège en carton ondulé imbibé de 50 $\mu$l de truncall I, la phéromone de *Prostephanus truncatus*. En supplément un sachet alimentaire a été déposé pendant deux périodes d'environ six mois. Les sites de piégeage se trouvaient au dehors de dépendances qui n'étaient pas employées pour le stockage du grain.

Les sachets de nourriture ont été particulièrement efficaces pour capturer les coléoptères adultes, mais ils ont aussi capturé des larves de lépidoptères. Quarante-quatre espèces ont été répertoriées : 37 coléoptères et 7 lépidoptères. Ces pièges ont aussi capturé Psocoptères, Thysanoures et Acariens, mais leur identification n'a pas été tentée. *Rhyzopertha dominica* et *Sitophilus zeamais* ont été les coléoptères les plus abondants et les mieux répartis. D'autres espèces très communes ont été capturées comme *Lasioderma serricorne*, *Tricorinus confusus*, *Tribolium castaneum*, *Cryptolestes pusillus*, *Carpophilus dimidiatus* (groupe) et *Sitophilus oryzae*. Le lépidoptèrele plus commun était *Sitotroga cerealella*. Pour plusieurs espèces, les prises ont diminué de décembre à mars et ont atteint leur maximum de juin à août, ce qui coïncidait avec la période où le maïs est mûr dans les champs.

Les pièges en carton ondulé n'ont capturé aucun Bostrychidae. Les pièges à glu n'ont capturé qu'un seul *P. truncatus* à l'automne et plusieurs *R. dominica* pendant toute l'année, avec un accroissement de population qui a commencé en avril.