

An introductory study of storage insect pests in Iran

Seyed Hamidreza FORGHANI^{1,*} and Aref MAROUF²

1. Seed and Plant Certification and Registration Institute, P.O.Box:31535-1516, Karaj, Iran.

2. Iranian Research Institute of Plant Protection P.O. Box 19395-1454, Tehran, Iran.

*Corresponding author, S.H. Forghani, E-mail: forghani51@gmail.com

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Abstract. It has been long reported that storage pests inflict great deal of damages on grain yields across the world. Stores in the central provinces of Iran are specially dominated with pest population. To address the problem, a research project was conducted to identify the main pests of wheat and barley grains in eight provinces during 2011. Different samples were collected from 20 stores, later on were incubated under lab conditions (25 ± 1)°C; (16L:8D) and RH (35±5) % and finally different species of insects were identified and recorded as followings: *Sitophilus granarius* (Linné, 1758), *Sitophilus oryzae* (L), *Tribolium castaneum* (Herbst, 1797), *Trogoderma granarium* Everts, *Trogoderma variabile* Ballion, *Tenebrio* sp., *Dermestes* sp.. Comparing the population figures *Sitophilus oryzae* identified as the most abundant pest species with in this region. In addition, for the first time in Iran, *Trogoderma variabile* was identified and reported in this study. The findings could be applied as the first step at grain stores in decision making for integrated pest management in these areas.

Key words: storage insects, wheat, barley, Iran.

Introduction

Insects are considered as the significant and primary pests of stored products that present damage to the grains through direct feeding during some of their lifecycles; resulting large populations and considerable damages (Haines 1991, Weidner & Rack 1984, Rees 1990, Shires, 1982). Grains and the other seed productions are frequently infested by various pest arthropods (Campbell et al. 2004, Thind & Dunn 2002, Olsen 1998, Stejskal & Verner 1996, Sinha & Watters 1985). The continual presence of insects and mites in workplaces involving environmental stores may lead to the development of occupational difficulties aspect of different problems for farmers, millers, bakers and other food industry operators (Alvarez et al. 1996, Tee et al. 1992, Revsbeck & Dueholm 1990). Cereal stored may be used up by some groups of pest arthropods including mites, psocids, beetles and moths (Stejskal & Verner 1996, Sinha & Watters 1985). About 25 percent of insects are related to coleopteran order so as to some of these insects could create decay on many seeds in grain stores and bring about a reduction in the weight and seed quality (Borrer et al. 1989). As a case in point, *Sitophilus oryzae* L. (Coleoptera: Curculionidae) and *Rhyzopertha dominica* (Fabricius) (Coleoptera: Bostrichidae) are well-known as the major pests for stored grain especially on wheat (Dalbelo et al. 2002). In Iran, beetles of the genus *Sitophilus* are resulted to obvious damages (up to 75%) on plenty of seeds in some way (Bagheri-Zenouz 2007). There was a report for different pests of seeds particularly wheat and barley on grain stores around Iran (Forghani et al. 2011a, Forghani et al. 2011b, Forghani et al. 2013). Storage pests mostly display the factual destruction on grains, cereal and oil seeds in distinctive climates (Behdad 2002). The pest, *S.oryzae*, shows close resemblance to *Sitophilus granarius* (Linné, 1758) (Coleoptera: Curculionidae), but it is more adapted to tropical and sub-tropical regions and may cause additional activity and injury on seeds (Long staff 1981, Anon 1985). The storage of sorghum, rough rice, millet and grains is usually occupied by grain weevils but more by moth like *Sitotroga cerealella* olivier (Lepidoptera: Gelechiidae) is likely to be more successful (Giles 1965, Wong &

Pedersen 1990). It is believed that *S.granarius*, *Cryptolestes ferrugineus* (Stephens, 1831) (coleopteran: Cucujidae), *Tribolium castaneum* (Herbst, 1797) (Coleoptera: Tenebrionidae) and *Oryzaephilus surinamensis* (Linné, 1758) (Coleoptera: Cucujidae), are the secondary stored-product pests and *S.granarius* is alluded as the most plentiful species in the Czech Republic (Kucerova et al. 2005). Stejskal and Hubert (2008) surveyed lot of grain storage units for pest composition and density. It was established that there are four dependent densities by psocids, beetles, moths and mites.

The main objective of this study was to re-identify of insect pest in stores which are located in central regions of Iran. Inasmuch as recently there was no report in this case after a long time on stored grains. Then, it is completely agree with the first step to manage the store and control pests are arose of the identification insects.

Materials and methods

Esfahan, Tehran, Alborz, Ghom, Ghazvin, Markazi and Semnan (Fig. 1) were the major significant provinces in central parts of Iran that consisted of 20 dedicated stores. In this research, we collected seed samples from 27 varieties of barley and 24 of wheat. We chose some tools to collect samples such as sample probe, brush, pitfall trap and other equipment. Sample probe used for collecting insects from seed free on floor and seed pocket according to ISTA (2010) and Rees (2008). All collected seeds specimen were put on some box and covered with the net material then, replaced into the germinator with constant condition: (25 ± 1)°C; (16L:8D) and RH (35±5) % for 2 months (Fig. 2). Afterwards, we isolated the insects from boxes and put into some small tube containing of 70% Alcohol and 5% Glycerin. The studies carried out under a dissecting microscope at magnifications up to 70X and classified all collected insects. Ultimately, specimens were sent to Tehran Plant Protection Institute to final identification.

Results

It was found a few insect pests in collections from some parts of Iran. There were no pest in Ghom, Markazi, Qazvin and Esfahan, however, Tehran, Alborz and Semnan had some insect pests in seed-samples. All results have been pre-



Figure 1. The studied regions.



Figure 2. Prepared samples in growth chamber (Original).

sented in Table 1.

As it is mentioned in Semnan province (Shahrood) the insect, *Trogoderma variabile* Ballion (Coleoptera: Dermestidae) (Supplementary material 1 - figures), was found on Kavir-Mother cultivar whereas, on Alvand had been found six species of insects consist of: *S. granarius*, *S. oryzae*, *Tribolium castaneum*, *Dermestes*, *Tenebrio* and *Trogoderma granarium*. In Semnan some species: *Trogoderma granarium*, *T. variabile*, *Tenebrio*, *Dermestes* and *S. oryzae* recognised on Shiraz cultivar while, the two species of *S. granarius* and *S. oryzae* were collected in Kavir-Mother cultivar. In this matter, *Tenebrio* and *S. oryzae* were found on Pishtaz in Alborz (Karaj). Moreover, in Tehran (Varamin) was observed *Tenebrio* on Reyhane 03 even though at the same place *Tribolium castaneum* and *S. oryzae* were recognized on Mother 03.

Also, Rice weevil, *Sitophilus oryzae*, should be considered as the dominating species in these regions because of the fact that it was found from different parts with high distinction numbers than the other species. Rice weevil from three provinces and four cities was collected on four wheat cultivars (Alvand, Shiraz, Pishtaz and Mother 03) and one barley cultivar (Kavir-Mother).

As well, warehouse beetle, *Trogoderma variabile* reports for the first time from Iran (In Semnan on Shirz cultivar). It had 2.1 mm, blight-brown color with tiny-fine hairs on its

Table 1. The identified pests on different seeds (wheat and barley) in central parts of Iran (wheat=W, barley= B).

Province/city(Place)	Cultivar	Pest
Ghom	Reyhaneh 03 (B)	-
Ghom	Nosrat (B)	-
Ghom	Karoon (B)	-
Ghom	Kavir (B)	-
Ghom	Kavir-Mother (B)	-
Ghom	DD10 (B)	-
Ghom	D5 (B)	-
Markazi/Saveh	Pishtaz (W)	-
Markazi /Saveh	Sardari-G (W)	-
Markazi /Saveh	Makoei (B)	-
Markazi /Saveh	Nosrat (B)	-
Markazi /Saveh	Bahar (W)	-
Markazi /Saveh	Back-cross (W)	-
Markazi /Saveh	Reyhane 03 (B)	-
Arak	Sardari (W)	-
Arak	Back-cross (W)	-
Tehran/Varamin	Mother 03 (W)	<i>Tribolium castaneum</i> , <i>S. oryzae</i>
Tehran/Varamin	Nosrat (B)	-
Tehran/Varamin	Reyhane 03 (B)	<i>Tenebrio</i>
Alborz	Pishtaz (W)	<i>Tenebrio</i> , <i>S. oryzae</i>
Alborz	Bahar (W)	-
Semnan	Shirz (W)	<i>Trogoderma granarium</i> , <i>T. variabile</i> , <i>Tenebrio</i> , <i>S. oryzae</i> , <i>Dermestes</i> ,
Semnan	Nosrat-M (B)	-
Semnan	Kavir (B)	-
Semnan	Reyhane 03 (B)	-
Semnan	Bam (W)	-
Semnan	Bahar (W)	-
Semnan	Kavir-M (B)	<i>Sitophilus granarius</i> , <i>S. oryzae</i>
Semnan /Shahrood	Alvand (W)	<i>S. granarius</i> , <i>S. oryzae</i> , <i>Tribolium castaneum</i> , <i>Dermestes</i> , <i>Tenebrio</i> , <i>Trogoderma granarium</i>
Semnan /Shahrood	Kavir-M (B)	<i>Trogoderma variabile</i>
Semnan /Shahrood	Makoei (B)	-
Semnan /Shahrood	Bahman (B)	-
Semnan /Shahrood	Kavir- G (B)	-
Garmsar	Nosrat (B)	-
Garmsar	Pishtaz -M(W)	-
Garmsar	Pishtaz (W)	-
Garmsar	Makoei (B)	-
Qazvin	Pishtaz 1 (W)	-
Qazvin	Pishtaz 2(W)	-
Qazvin	Pishtaz 3 (W)	-
Esfahan	Bahman (B)	-
Esfahan	Rodasht-M (B)	-
Esfahan	Sepahan-G (W)	-
Esfahan	Back cross (W)	-
Esfahan	Pishtaz (W)	-
Esfahan	Bahar (W)	-
Esfahan	Alvand (W)	-
Esfahan	sw-82-9 (W)	-
Esfahan	Reyhane 03 (B)	-
Esfahan	Fajr 30 (B)	-
Esfahan	Nosrat (B)	-

oval body. The most important characteristics of the two sexes are compared in the following pictures.

Discussion

In our research, some insect pests including: *Sitophilus granarius*, *Sitophilus oryzae*, *Tribolium castaneum*, *Trogoderma granarium*, *Trogoderma variabile*, *Tenebrio sp.* and *Dermestes sp.* identified in few grain stores in central parts of Iran. We found that most of them could be considered as the predominant harmful pests which bring about damages on grain stores particularly on wheat and barley. In similar results were observed that some insects associated with stores in Kansas and there are 30 species from 20 families of insects such as, *Sitophilus spp.*, *Plodia interpunctella* Hb. (Lepidoptera: Phycitidae) and *Tribolium castaneum* that the numbers of each insect species varied from different stores (Roesli et al. 2003). Furthermore, Subramanyam and Hagstrum (1996) remarked arthropods mostly make infestation on grain economically, since these pests lead to enormous losses of stored products worldwide. In addition, in the humid tropics a few insect pests sometimes occur as troublesome pests on grains, notably milled rice, in which they are sometimes very abundant (Rees, 1990). Serious primary pests, such as *S. granarius*, *T. castaneum*, *O. surinamensis* and *C. ferrugineus*, can appear and survive outside in the vicinity of storage space facilities during the temperate period of year in the Czech Republic (Stejskal & Hubert 2008). It is clear cut that insect pests probably exist inside or outside place and store to store there are different species on grain or other products and certainly, a great deal of reasons have been interfered for these findings. Namely, condition of climate, seed varieties and storage equipments may affect on presence of various pests and their populations.

Besides we found that *S. oryzae* may consider as the dominant species in grain stores. It was dispersed more than the other pests and collected from most of locations. With this respect, the other studies have showed that the grain weevils are well-known as major primary pests of stored grains. They are able to establish themselves on whole, undamaged grains of maize, sorghum, rice and wheat. As an illustration, *Sitophilus zeamais* Motsch (Coleoptera: Curculionidae) is the serious species on maize while *Sitophilus oryzae* is the main pest on wheat. (Haines 1991, Weidner & Rack 1984). Similarly, there are biotypes of *S. oryzae* that multiply on stored split peas (Holloway 1986) and on mung beans successfully (CP Haines, personal communication). Certain strains of *S. oryzae* have been noted as having greater flight proclivity than others (Kiritani 1959). In a research, the bostrichid beetle, *Prostephanus truncatus* Horn (Coleoptera: Bostrichidae), (the Larger Grain Borer) was a highly destructive primary pest of maize, particularly maize stored on the cob. This insect is now established in several East and West African countries. (Dick 1988, McFarlane 1988a). Then, it seems that kind of seed, place and storage condition may result an especial circumstances for this pest. In the same issue, Golob (1988) believed that the grain moth, *Sitotroga cerealella*, has destroyed the mass of maize especially on the cob without the sheath in number of African countries. Thus, it depicts that few results are fitted with our findings and another outputs are related to kind of store products, storage circumstances and their places. Although the climate condition was close together in our study in most parts, few stores were observed by presence of pests. For instance, in Semnan

insect pests were only discovered on Shiraz cultivar (wheat) and Kavir-Mother (barley), in spite of that there was no pest on the others; Nosrat and Kavir cultivars (barley) or Bahar and Bam cultivars at the same condition simultaneously. Furthermore, in Alborz, Pishtaz variety showed the pest pollution yet, Bahar was without anything. So, some aspects like kind of cultivar may be effective the pollution to pest. Correspondingly, Bheemanna et al. (1994) described that in sorghum rice weevil had more damage and population on CSH1 versus of DMC6. Moreover, Kurdikeri et al. (1993) discovered on maize (Dekan 103 variety) *Sitophilus oryzae* appeared with the most frequency of population. Hence, seeds have distinction sensitivity and its tolerance might be different in front of destructive elements such as pests. This matter also is debated by Evans (1987b) that to all storage insects, population growth rates and insect development are more perceptibly affected by temperature (Harrington & Douglas, 1970). Kind of seed variety with the other aspects of storage are discerned by Bagheri-Zenouz (2007), Banks (1994), Appert (1993), Murphy and Todd (1993), Arbogast (1991), Haines (1991) and Aitken (1975). Therefore, storage management which may be described as the science of cost-effective storage organization (McFarlane, 1988b), greatly influences pest development and control. It encompasses decisions upon seed variety, the location of stores, storage periods and the quality control objectives for stored commodities. All of these especially identification of pests in early step have substantial implications for pest management and are components of the complex interactive network of factors affecting loss reductions in storage grain.

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References

- Aitken, A.D. (1975): Insect travellers. Volume 1. Coleoptera. Technical Bulletin 31, HSMO, xvi. Ministry of Agriculture Fisheries and Food: London, UK.
- Alvarez, M.J., Tabar, A.L., Quirce, S., Olaguibel, J.M., Lizaso, M.T., Echechipia, S., Rodriguez, A., Garcia, B.E. (1996): Diversity of allergens causing occupational asthma among cereal workers as demonstrated by exposure procedures. *Clinical & Experimental Allergy* 26: 147-153.
- Anon. (1985): Manual of pest control for food security grain stocks. FAO Plant Production and Protection Paper No.63, Food and Agricultural Organisation of the United Nations, Rome, viii+200 pp.
- Appert, J. (1993): The storage of food Grains and seeds, published in co-operation with the Technical centre for Agricultural and Rural co-operation, p.o.B.: 380, 6700Aj Wageningen, The Netherlands.
- Arbogast, R.T. (1991): Beetles: Coleoptera. pp. 131-176. In: Gorham, J.R. (ed.), Ecology and management of food industry pests. FDA Bulletin 4. Food and Drug Administration: Washington DC, USA.
- Bagheri-Zenouz, A. (2007): Pests of stored Products and management to maintain, University of Tehran Press, Vol. 1, 450p.
- Bagheri-Zenouz, A. (1985): Damaging Coleoptera on nourishments products (store pests and it controlling methods), Sepehr Press, Vol. 1, 327p.
- Banks, H.J. (1994): Illustration keys for *Trogoderma granarium*, *T. glabrum*, *T. inclusum* and *T. variabile* (Coleoptera: Dermestidae) and other *Trogoderma* associated with stored products. CSIRO Division of Entomology Technical paper. No. 32, CSIRO, Canberra, Australia.
- Bheemanna, M., Kulkarni, K., Shekharappa, A. (1994): Relative susceptibility of some sorghum genotypes to rice weevil. *Journal of Maharashtra Agriculture University* 19: 148.
- Campbell, J.F., Arthur, F.H., Mullen, M.A. (2004): Insect management in food processing facilities. *Advanced Food Nutrient Research* 48: 239-295.

- Dick, K. (1988): A review of insect infestation of maize in farm storage in Africa with special reference to the ecology and control of *Prostephanus truncatus*. Overseas Development Natural Resources Institute Bulletin No. 18, v+42 pp.
- Evans, D.E. (1987b): The influence of rate of heating on the mortality of *Rhizopertha dominica* (F.) (Coleoptera: Bostrichidae). *Journal of Stored Products Research* 23: 73-77.
- Forghani, S.H.R., Maroof, A., Shahbazi, R. (2011a): An investigation on the abundance population by seed pests of wheat and barley in grain store in central regions of Iran, final report of research project for Seed and Plant Certification and Registration Institute, AREEO, Ministry of Jihad-e-Agriculture, Approved No. 2-08-08-89010, Record No. 499/222 38p.
- Forghani, S.H.R., Maroof, A., Hamidi, A., Honarparvar, N. (2011b): Identification of pests grain Store in central parts of Iran, 2th National Conference of Seed Science Technology, Islamic Azad University of Mashhad, Iran, pp.: 2012-2016.
- Forghani, S.H.R., Maroof, A., Honarparvar, N. (2013): Insect pests on stored wheat and barley in central parts of Iran, 4th of International Conference on Insect Science, University of Agricultural Science, Feb. 14-17, 2013, Bangalore, India, pp.: 96.
- Giles, P.H. (1965): Control of insects infesting stored sorghum in Northern Nigeria. *Journal of Stored Products Research* 1: 145-158.
- Golob, P. (1988): Current status of the Larger Grain Borer *Prostephanus truncatus* (Hoary) in Africa. *Insect Science and its Application* 9(6): 737-745.
- Haines, C.P. (1991): Insects and arachnids of tropical stored products: their biology and identification, 2nd ed. Natural Resources Institute, Overseas Development ministration, Kent, United Kingdom.
- Harrington, J.F., Douglas, J.E. (1970): Seed storage and packing. National seed crop and Rockefeller foundation. New Delhi, p.222.
- Holloway, G.J. (1986): The potency and effect of phytotoxins within yellow split peas (*Pisum sativum*) and adzuki bean (*Vigna angularis*) on survival and reproductive potential of *Sitophilus oryzae* (L.) (Coleoptera: Curculionidae). *Bulletin of Entomological Research* 76(2): 287-295.
- ISTA. (2010): Rules Proposals for the International Rules for Seed Testing 2010 Edition, OM Rules Proposals for the International Rules for Seed Testing 2010 Edition.doc. Approved by ECOM Decision, No.498, 51p.
- Kiritani, K. (1959): Flying ability and some of the characters associated with it in Calandra. *Japanese Journal of Ecology* 9(2): 69-74.
- Kucerova, Z., Aulicky, R., Stejskal, V. (2005): Outdoor Occurrence of Stored-Product Pests (Coleoptera) in the Vicinity of a Grain Store, *Plant Protection Science* 41: 86-89.
- Kurdikeri, M.B., Aswathaih, B., Rajendra P., Katagal, R.D., Aswathanarayana, S.C. (1993): Studies on relative seed damage loss in weight and loss in viability caused by *Sitophilus oryzae* Linn. and *Rhizopertha dominica* Fab. in maize hybrids. *Seed Research Journal* 21 : 72-77.
- McFarlane, J.A. (1988a): Pest management strategies for *Prostephanus truncatus* (Horn) (Coleoptera: Bostrichidae) as a pest of stored maize grain: present status and prospects. *Tropical Pest Management* 34(2): 121-132.
- McFarlane, J.A. (1988b): Storage methods in relation to postharvest losses in cereals. *Insect Science and its Application* 9(6): 747-754.
- Olsen, A.R. (1998): Regulatory action criteria for fi lth and other extraneous materials. II. Allergenic mites: an emerging food safety issue. *Regulatory Toxicology & Pharmacology* 28: 190-198.
- Rees, D. (1990): The effect of temperature and relative humidity on population growth of three *Liposcelis* species (Psocoptera: Liposcelidae) infesting stored products in tropical countries. *Bulletin of Entomological Research* 80: 353-358.
- Rees, D. (2004): Insects of stored products. CSIRO publishing, Collingwood, VIC: Australia.
- Rees, D. (2008): Insects of stored products, sbs publisheds & distributors pvt. Ltd., New Delhi-110002, India, 181p.
- Revsbech, P., Dueholm, M. (1990): Storage mite allergy among bakers. *Allergy* 45: 204-208.
- Shires, S.W. (1982): Observations on *Liposcelis bostrychophilus* Badonnel (Psocoptera). *Tropical Stored Products Information* 44: 11-14.
- Sinha, R.N., Watters, F.L. (1985): Insect pests of fl our mills, grain elevators, and feed mills and their control. Research Station Winnipeg, Manitoba Publication, p.1776.
- Stejskal, V., Hubert, J. (2008): Risk of occupational allergy to stored grain arthropods and false pest-risk perception in Czech grain stores. *Annual Agricultural Environment Medical* 15: 29-35.
- Stejskal, V., Verner, P.H. (1996): Long term changes of cockroach infestations in Czech and Slovak food-processing plants. *Medical Veterinary Entomology*, 10: 103-104.
- Subramanyam, B., Hagstrum, D.W. (1996): Integrated management of insects in stored products. Marcel Dekker, New York.
- Tee, R.D., Gordon, D.J., van Hage-Hamsten, M., Gordon, S., Nunn, A.J., Johansson, S.G., Taylor, A.J. (1992): Comparison of allergic responses to dust mites in U.K. bakery workers and Swedish farmers. *Clinical & Experimental Allergy* 22: 233-239.
- Thind, BB., Dunn, J.A. (2002): A laboratory evaluation of a regulated airflow through wheat at four combinations of temperature and humidity on the productivity of three species of stored product mites. *Experimental and Applied Acarology* 27: 89-102.
- Weidner, H., Rack, G. (1984): Tables de determination des principaux ravageurs des denrées entreposées dans les pays chauds. GTZ Schriftenreihe No. 129; Eschborn, Germany, 148 pp.

+ One page supplementary material, available exclusive online
(Photo with *Trogoderma variabile* male and female)