RESULTS AND DISCUSSION

The abundance of *R. dominica* in wheat in autumn 1995 and spring 1996 is shown in Table 1. These data confirm the ability of *R. dominica* to produce and maintain continuous, local populations that survive the winter. The ambient winter temperatures (Fig. 1) did not allow any re-infestation and re-colonisation of silo bins from external sources. Instead, the extraordinarily high subsurface grain temperatures (hot spots) found in the infested silos (Table 1) provided an optimal microclimate for pest development, although outdoor temperatures were low enough to avoid infestation of a properly cooled silo. In the infested bins other pests were also present, predominantly Coleoptera: *Sitophilus granarius, Oryzaephilus surinamensis, Tribolium castaneum, Alphitobius diaperinus, Latridius minutus*, and *Ahasverus advena*. The multi-species infestation may have had a synergetic effect on the winter population of *R. dominica*.

Problems with high infestations of grain with *R. dominica* were also reported recently as a new phenomenon in Canada (FIELDS *et al.* 1993). The authors proposed three hypotheses to explain the origin of massive infestations by *R. dominica*: (1) introduction of the pest from outside the area, (2) wind transport from other regions, (3) pest establishment in the grain stock, and successful survival over the winter (either as a result of increased cold-resistance, or by utilising high grain temperature). It is known that huge volumes of grain can retain a high temperature throughout winter, and pest organisms can by respiration even further increase grain temperature considerably. Although aeration systems are frequently installed to cool stored grain, they are lacking in many facilities while in others they are inadequate or operated inefficiently (BURRELL & HAVERS 1970).

The Canadian authors were unable to verify or reject any of those hypotheses. Yet our data leave little doubt that under certain circumstances *R. dominica* is able to overwinter in the Czech Republic, indicating the validity of the last-mentioned hypothesis. As we did not take any measurements of physiological parameters of the population observed, we cannot exclude the existence of some level of cold-tolerance and its impact on survival over the winter abilities. However, an exceptionally high level of cold-tolerance of *R. dominica* is improbable (FIELDS & WHITE 1997).

The mathematical models by SINGH and THORPE (1993) showed that moisture and temperature were lowest at the bottom of a grain bulk, whereas they were highest below the surface of the grain mass. Fungal and/or arthropod activity in these warm and humid grain layers frequently resulted in the development of high temperature zones known as hot spots (SINHA 1961). We suggest that hot spots are the main cause, and the basic ecological resource, for the survival over the winter of *R. dominica* in the Czech Republic and elsewhere in the temperate climatic zone. Our explanation is supported by the presence of hot spots with dense and thriving populations of *R. dominica* in the subsurface vapour-condensation layers of the grain mass, whereas the adult beetles collected within the cool bottom zone of the silo bins were dead (Table 1). The ecology of hot spots was extensively studied by Canadian scientists (SINHA 1961; SINHA & WALLACE 1966), but the fact that hot spots provide an ecological opportunity for tropical and subtropical species to increase their geographical ranges was obviously never suggested in the literature.

During the consequent faunistic research, further occurences of *R. dominica* in various grain stores in the Czech Republic were documented (e.g. in 1996 *R. dominica* was present in 14.1% of the 64 grain stores tested), which confirmed the preliminary results and the conclusion of this report.

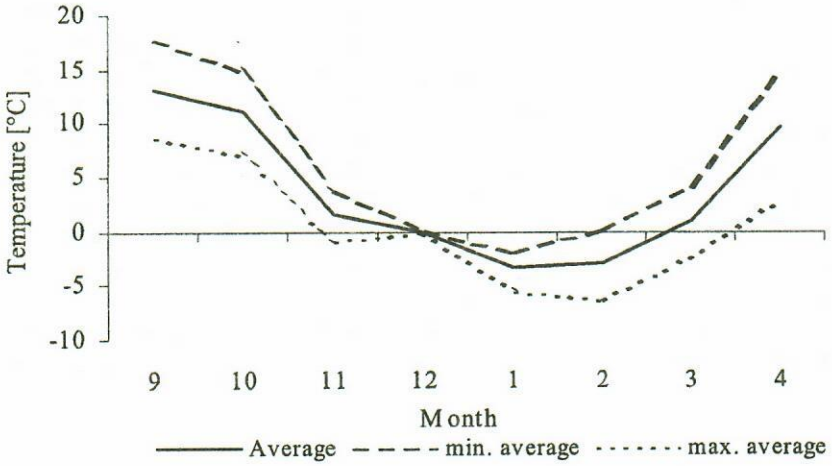

Fig. 1 Temperatures during winter 1995/96 in Central Bohemia

Table 1. Density of *Rhyzopertha dominica* (D – No. of live/dead adults per 2.5 kg sample) and wheat temperature ($T_{min-max}$ [°C]) in infested silos

Year	Sampling site	Bin No.1		Bin No.2		Bin No. 3		Bin No.4	
		D	T	D	T	D	T	D	T
1995	Surface	0/0	16–20	156/32	25–38	28/2	18–36	0/0	16–24
	Bottom	–	–	–	–	–	–	–	–
1996	Surface	105/7	8–38	896/265	39–45	2/130	16–28	0/ 0	5–20
	Bottom	0/0	4–6	0/41	4–8	0/1	4–8	0/2	4–5

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Souhrn

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Poprvé bylo v České republice zjištěno a zdokumentováno přežívání přemnožených populací korovníka obilního (*Rhyzopertha dominica*) během zimního období v ohniscích záhřevu ve skladovaném obilí. V mnoha případech nedokonalá technologie skladovaní obilí umožňuje vznik ohnisek záhřevu v podpovrchových vrstvách obilí a pravděpodobně tak vytváří vhodné podmínky k přezimování tohoto teplomilného druhu. Tato ohniska se pak stávají zdrojem dalších infestací. Byl zhodnocen ekologický význam ohnisek záhřevu v obilí jako potenciálního mechanismu pro rozšíření tropických škůdců do mírnějších pásem.

Klíčová slova: *Rhyzopertha dominica F.* (Coleoptera: Bostrichidae); technologie skladování obilí; vysoké a nízké teploty; geografické rozšíření

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