

# SCYMNUS NINGSHANENSIS YU ET YAO (COLEOPTERA: COCCINELLIDAE) FOR BIOLOGICAL CONTROL OF ADELGES TSUGAE (HOMOPTERA: ADELGIDAE)

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## Abstract

*Scymnus ningshanensis* is one of three Chinese lady beetles in the subgenus *Neopullus* imported into the USDA Forest Service Quarantine Laboratory, Ansonia, CT, as a biological control agent for the hemlock woolly adelgid (HWA), *Adelges tsugae*. These lady beetles are found separately in three provinces along the eastern edge of the Tibetan Plateau (Yunnan, Sichuan, and Shaanxi). *Scymnus ningshanensis* was collected near Ningshan in Shaanxi Province from *Tsuga chinensis*.

In China, *S. ningshanensis* adults became active in early April when the 10-day average temperature reached 7° C. Eggs are laid from April to June when HWA progrediens generation eggs are present. *Scymnus ningshanensis* was found only on hemlock; it was not on nearby *Pinus armandii* that was infested with another adelgid species.

In the laboratory, oviposition by *S. ningshanensis* began within a week after removal from cold storage (5° C). Oviposition in the laboratory lasted for 5 weeks, declined as the abundance of HWA eggs declined on foliage brought from the field, but reinitiated and continued for another 8 weeks when beetles were provided abundant HWA eggs on foliage held in cold storage. Oviposition occurred singly in concealed locations such as bud scales

and under the edge of ovisacs and averaged 1.6 eggs per day. Larvae consumed an average of 23 ovisacs, which averaged 35 eggs/sac. In feeding preference tests, *S. ningshanensis* adults preferred HWA to aphids but there is no preference between HWA and other adelgid species. Response to odor from HWA infested foliage was not observed in olfactometer tests; visual and tactile cues seemed more important.

A positive numerical response to prey density is an attribute of effective biological controls. We compared the oviposition of *S. ningshanensis* with that of another lady beetle, *Pseudoscymnus tsugae*, at different prey densities in the laboratory. *S. ningshanensis* responded to increasing prey densities by laying more eggs, but *P. tsugae* did not. We compared the impact of these two lady beetles on the net per-capita increase of HWA from one generation to the next. In early spring, the adult HWA (sistens generation) on a hemlock branch were counted. The branches were enclosed in bags containing either a male and female of *S. ningshanensis* or *P. tsugae*, or no beetle (control). The adelgids of the next generation (progrediens) were counted 10 weeks later. The population of adelgids in the bags containing *S. ningshanensis* lady beetles decreased, whereas adelgids increased in the bags with no beetles or *P. tsugae*.