

The toxicity of Neem to the snail

Arianta arbustorum

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Herbivorous land snail *Arianta arbustorum* Linnaeus, 1758 (*Gastropoda, Pulmonata, Helicidae*) has become considerable pest that occurs throughout Central, Eastern and Northern Europe. Commercially available neem formulation NeemAzal-T/S (containing 1 % azadirachtin, Trifolio-M GmbH, Germany) was tested on experimental white cabbage field of the Estonian University of Life Sciences against cabbage pests, including the snail *A. arbustorum*. The formulation was diluted with water and treated in concentrations 0.03 % and 0.3 % (solution/spraying and watering) with weekly intervals. After that the number of snails started to grow and the highest population peak was in the middle of September. All the tested neem concentrations affected the number of snails on the cabbage and were significantly different from control variant. There was no significant difference between treated variants. Both, spraying and watering with NeemAzal-T/S, affected *A. arbustorum* as effective repellent. It can be concluded that all neem treatments could control the snail *A. arbustorum*.

Key words: *Arianta arbustorum* L., NeemAzal-T/S, white cabbage.

Introduction. A lot of terrestrial gastropod species are important pests in agricultural and horticultural crops (Godan, 1983). The commonest and widespread hermaphroditic land snail *Arianta arbustorum* Linnaeus, 1758 (*Gastropoda, Pulmonata, Helicidae*) occurs throughout Central, Eastern and Northern Europe (Terhivuo, 1978; Kerney et al., 1983). *A. arbustorum* is an omnivorous snail that includes green plants, decaying plant material, and fungi in its diet (Hägele, 1992). The most commonly used chemical control is in the form of slug pellets, containing the active ingredient metaldehyde. Metaldehyde works by disrupting the gastric organs. Molluscicides may also contain a desiccant preventing mollusks from producing the mucous essential for survival. Pellets remain attractive to snails and slugs for several days to prolong the length of time they are available for detection (Pesticide Safety Directive, 2000). It is tempting to use chemical control in our gardens but care must always be taken as all pesticides are toxic to living organisms and the potential hazards are very real. With the increasing popularity of organic farming in the country, there is a need to use environment-friendly biopesticides and other bio-based tools to overcome the

problem of insect pests. Plants may be an alternative to the currently used insect control agents, because they virtually are a rich source of bioactive organic chemicals (Godfrey, 1995; Isman, 1997). Phytophagous land snails in greenhouses and horticulture were killed by neem preparations (West, Mordue, 1992). Biopesticide NeemAzal-T/S (Trifolio-M GmbH, Germany) is registered since 2000 in Germany (Isman, 2004) and since 2001 in Estonia. An extract “NeemAzal” obtained from seed kernels of the Neem tree *Azadirachta indica* A. Juss and its formulation contains about 54 % of azadirachtins. NeemAzal-T/S is a formulation of NeemAzal containing 1 % w/w of azadirachtin A. The results of studies of possible environmental impacts indicate an extremely low risk to aquatic organisms, microorganisms, earthworms, beneficial insects, honeybees, birds, etc. This is true especially in view of the low concentrations of azadirachtin A, which are required for sufficient control of pests (Kleeberg, 2004). Aim of the present study was to test different concentrations and treatment ways of neem formulation NeemAzal-T/S on white cabbage field against the herbivorous land snail *A. arbustorum*.

Object, methods and conditions. Field experiments were done to test the efficacy of the biopesticide NeemAzal-T/S (1 % azadirachtin, Trifolio-M GmbH, Germany) against the cabbage pests, including the snail *A. arbustorum*. The present experiment was carried out in the experimental garden of the Estonian University of Life Sciences in 2006. White cabbage (*Brassica oleracea* L. var. *capitata* f. *alba*) plants were grown from seed, kept in glasshouse until they reached the 3 true leaf stage. In mid-May the plants were replanted to the experimental field. Each variant consisted of 9 plants per plot (three rows of three plants spaced at 70 cm intervals). All variants had three replications. Different concentrations of NeemAzal-T/S were used – 0.03 % and 0.3 % for spraying and 0.3 % concentration of NeemAzal-T/S for watering of testing plots. Individuals of *A. arbustorum* on all the plots were sampled at 7 day intervals from 4 July to 12 September. To avoid repeated counting the snails were removed from plants by hand picking. The first spraying and watering with NeemAzal-T/S was made after the first counting on 4th of July. Treatments were applied at weekly intervals during the entire observing period. Tests were performed using the statistical package StatSoft ver. 7, Inc. / USA. Data have been presented as mean \pm standard error. Statistical comparisons were performed with repeated-measures by the Fisher LSD test. All means were considered significantly different at the $p < 0.05$ level.

Results. The snail *A. arbustorum* appeared on the white cabbage in the beginning of August whereupon the number of snails started to grow. The highest population peak was in the middle of September (Fig. 1).

All the tested neem concentrations affected the snail and were significantly different from control variant. A comparison of treated variants with control revealed significant differences in the number of *A. arbustorum* individuals (ANOVA $F(3,128) = 8.75$; $df = 3$; $p < 0.05$: LSD test $p < 0.05$). There was found no significant difference among treated variants' snail numbers (LSD test, $p > 0.05$) (Fig. 2).

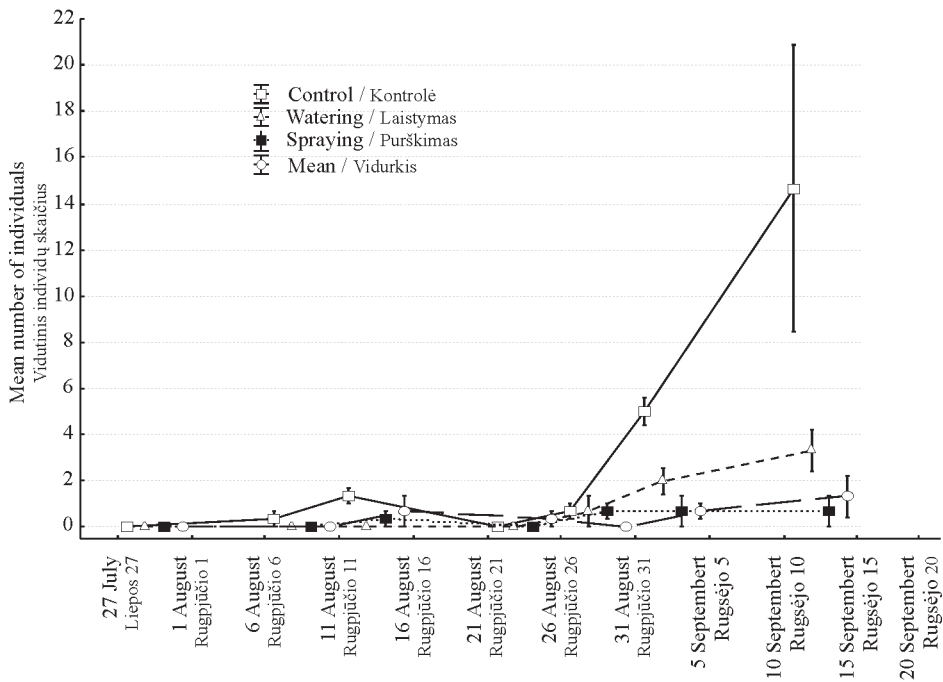


Fig. 1. Seasonal dynamics of land snail *Arianta arbustorum* on differently NeemAzal-T/S treated variants (mean \pm SE)

1 pav. Margujų medšraigių *Arianta arbustorum* sezoninis gausumo kitimas skirtingai nimazaliu apdorotuose variantuose (vidurkis \pm SE)

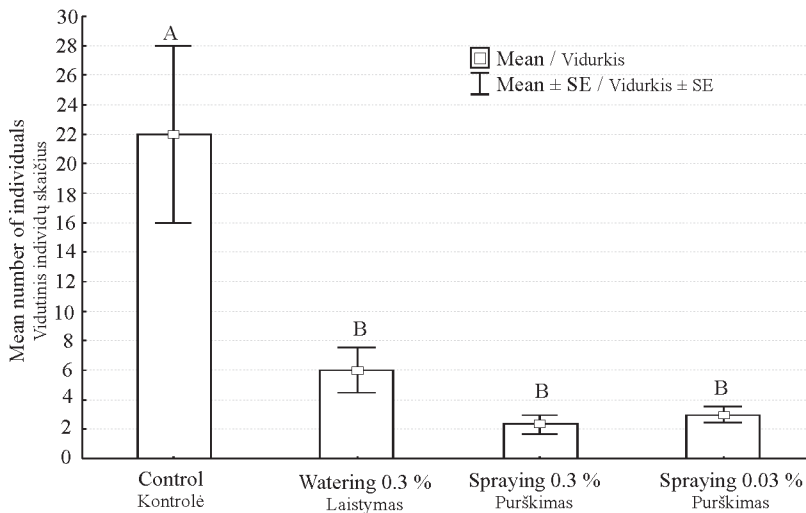


Fig. 2. Mean number of individuals of land snail *Arianta arbustorum* on neem treated variants. Columns with different letters are significantly different (Fisher LSD test $p < 0.05$)

2 pav. Vidutinis margujų medšraigių *Arianta arbustorum* skaičius neem purkštuose variantuose. Stulpeliai pažymėti skirtingomis raidėmis patikimai skiriasi (Fišerio testas R_{05})

These data suggest that *A. arbustorum* was sensitive to NeemAzal-T/S because the number of snails remained relatively low on treated variants. The comparison of the differently treated variants revealed that the land snail *A. arbustorum* selected least the plots sprayed with 0.3 % neem formulation (7 %), followed by sprayed with 0.03 % neem (11 %) as the site for feeding and the third choice was watered variant 0.3 % neem (17 %).

Discussion. Mollusc herbivory is generally considered to be of ecological importance only during seedling period (Hanley et al., 1995 a, b). However, in suitable mollusk habitats, mollusk biomass is high, and they may well be a major basal component of the food chain. Consequently, mollusk in these habitats should not only affect seedlings but also exert some pressure on fully-grown plants (Hägele et al., 1998). Damage is caused by gastropods due both to feeding and to contamination of the harvested plants with their bodies, eggs, faeces or slime, leading to deterioration in the quality of the harvest and financial loss (South, 1992). The compounds from neem *A. indica* have a number of properties useful for pest management. These include repellence, feeding and oviposition deterrence, insect growth regulator activity, low mammalian toxicity and low persistence in the environment (Schmutterer, 1990; Koul, 1992). It is evident from our results that the NeemAzal-T/S we tested had a repellent effect on the snail *A. arbustorum*. Some test results prove the neem oil molluscicidal activity. Neem oil significantly reduced fecundity, egg viability, and survival of the giant African snail *Achatina fulica* (Rao, Singh, 2000). Neem oil resulted in extension of the nymphal period and dose-dependent mortality in some homopterous insects (Schmutterer, 1990). Singh and Singh (2000) while studying the effect of *Allium sativum*, *A. indica* and *Zingiber officinale* on the reproduction of the snail *Lymnaea acuminata* reported that their active molluscicidal constituents allicin, azadirachtin, and [6]-gingerol (Singh, Singh, 1995; Singh et al., 1996; 1997) caused a significant reduction in the fecundity, egg viability, and survival of young snails. Treatment of 60 % of LC50/24 h of allicin and [6]-gingerol eliminated fecundity in snail *L. acuminata*.

Conclusion. In our research both spraying and watering with NeemAzal-T/S affected *A. arbustorum* as effective repellent. It can be finally concluded that all neem treatments could affect the snail *A. arbustorum*.

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Neem toksiškumas medsraigei *Arianta arbustorum*

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Santrauka

Margosios medsraigės *Arianta arbustorum* Linnaeus, 1758 (*Gastropoda, Pulmonata, Helicidae*) tampa žalingais kenkėjais. Jų randama centrinėje-rytinėje ir šiaurinėje Europoje. Pramoniniu būdu gaminama neem formuluotė nimazalis-T/S (turintis 1 % azadirachtino, Trifolio-M GmbH, Germany) buvo bandomas Estijos gamtos mokslų universiteto eksperimentiniuose baltagūžių kopūstų laukuose kovojant su kopūstų kenkėjais ir sraigėmis *A. arbustorum*. Preparatas buvo atskiestas vandeniu ir naudotas 0,03 % ir 0,3 % koncentracijų (tirpalas purkšti arba laistyti) kas savaitę. *A. arbustorum* pasirodo rugpjūčio pradžioje. Po to sraigių gausėja, ir daugiausia jų būna rugsėjo viduryje. Visos bandytos neem koncentracijos veikė sraiges ant kopūstų ir patikimai skyrėsi nuo kontrolinio varianto. Tarp apdorotų variantų patikimų skirtumų nebuvo. Ir laistymas, ir purškimas nimazaliu-T/S buvo veiksmingas *A. arbustorum* repelentas. Galima daryti išvadą, kad ir purškimas, ir laistymas nimazaliu gali reguliuoti sraigių *A. arbustorum* skaičių.

Reikšminiai žodžiai: *Arianta arbustorum* L., baltagūžiai kopūstai, nimazalis.