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ASSESSMENT OF GREEN OAK LEAF-ROLLER (*TORTRIX VIRIDANA, LEPIDOPTERA: TORTRICIDAE*) ACTIVITY USING PHEROMONAL TRAPS

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Abstract. *Defoliating insects active in early spring, such as Tortrix viridana and certain Geometridae species, can reduce fruit production by consuming flower buds or inducing physiological imbalances that disrupt floral induction and acorn development. Although Tortrix viridana is polyphagous, it exhibits a marked preference for oak (Quercus spp.). However, under conditions of food scarcity, mature larvae may switch to alternative hosts, including apple (Malus domestica) and pear (Pyrus communis), especially in orchards. Despite its ecological and economic relevance, data on the species' dynamics in western Romania are limited. Therefore, this study aimed to monitor the population dynamics of Tortrix viridana in Timiș County in relation to host plant type and climatic conditions, with additional focus on vertical distribution within the tree canopy. Fieldwork was conducted during the 2022 season at two sites: a family orchard in Dudeștii Noi and the USVT experimental park in Timișoara. Adult moths were monitored using Delta traps baited with atraVIR pheromone lures, while larvae were quantified via the "100 leaves" method, with sampling from three canopy levels. Results revealed clear host-dependent variability. Apple trees recorded the highest larval and adult densities, suggesting an emerging trophic shift toward cultivated hosts. Although ANOVA did not indicate statistically significant differences, this trend was supported by post-hoc analysis and high variability, especially in apple plots. Additionally, population peaks coincided with specific climatic windows, underscoring the role of microclimate in phenological development. These findings support the hypothesis of behavioral adaptation in Tortrix viridana and highlight the need for targeted monitoring and predictive models in orchard ecosystems.*

Keywords*: Tortrix viridana, oak, apple, pear, orchards, pheromonal traps*

INTRODUCTION

In recent decades, the regeneration of oak forests (*Quercus* spp.) has been increasingly constrained by the synergistic effects of both abiotic and biotic stressors. Repeated droughts, late spring frosts, insect outbreaks, and maladaptive forest management practices have all contributed to a noticeable decline in oak vitality and reproductive success across Europe (BRANG et al., 2014; LINDNER et al., 2010; MÁTYÁS & JUMP, 2015). As a result, oaks have exhibited reduced and irregular acorn production, which threatens their natural regeneration potential in many temperate ecosystems.

Among the biotic stressors, defoliating insects play a particularly damaging role. Their feeding reduces photosynthetic capacity, induces metabolic disorders, and disrupts bud development, especially when attacks occur over consecutive years (NETHERER & SCHOPF, 2010; LEUSCHNER & MEIER, 2018). Species with early spring activity, such as *Tortrix viridana* and various *Geometridae*, are especially problematic, as they feed during the budburst and floral organ development phase, reducing fruiting directly - by consuming flower buds - and indirectly - by disturbing hormonal pathways responsible for floral induction and acorn retention (VAN ASCH & VISSER, 2007; IVASHOV et al., 2002 a; DULAURENT et al., 2012).

Tortrix viridana, the green oak leafroller, is considered one of the most serious oak defoliators in Europe, Western Asia, and North Africa. With a univoltine life cycle, the species synchronizes larval emergence with oak budburst, maximizing feeding efficiency on sensitive tissues. Although polyphagous in later larval stages, it shows a marked preference for oaks, particularly *Quercus robur*, but can also feed on other deciduous species and fruit trees such as apple (*Malus domestica*) and pear (*Pyrus communis*) under food shortage conditions (GROß et al., 2018; MIHAJLOVIĆ, 1986).

Recent studies have revealed that *Tortrix viridana* is not only a foliar pest but also capable of manipulating the host tree's chemical defenses. *Quercus robur* emits volatile organic compounds (VOCs) as a natural response to herbivory, yet *Tortrix viridana* can suppress or interfere with these signals, effectively "tricking" the oak into lowering its defense levels, which facilitates continued larval feeding and survival (GHIRARDO et al., 2012).

Despite the species' wide distribution, there is a notable lack of ecological and population data for *Tortrix viridana* in western Romania, particularly in Timiș County. In this context, the objective of the present study was to monitor the population dynamics of *Tortrix viridana* in two different environments – USVT Park and a private orchard in Dudeștii Noi – using pheromone traps and field observations. Furthermore, the study aimed to assess the moth's trophic preferences across different host plants (oak, apple and pear) and vertical feeding distribution within the tree crown, while also examining correlations with climatic variables.

MATERIAL AND METHODS

Investigated Area

The field investigations were carried out during the 2022 growing season at two distinct locations within Timiș County, Romania: a family-operated orchard situated in the locality of Dudeștii Noi (45°50′21.3″N 21°06′11.1″E) and the experimental park of the University of Life Sciences "King Mihai I" in Timișoara (45°46'55.2"N 21°13'06.7"E). These sites were strategically selected to facilitate the comparative study of *Tortrix viridana* population dynamics across two contrasting ecological settings—namely, an agroecosystem and an urban green infrastructure with complementary educational and landscape functions.

The orchard was established on flat, uniform terrain characterized by homogeneous soil conditions and permanent grassy inter-row cover. Tree planting followed the methodological framework recommended by SĂULESCU & SĂULESCU (1967), with a spacing of 4 meters between rows and 1 meter between individual trees. The experiment employed two fruit tree cultivars: Golden Delicious (apple) – an American cultivar known for its medium-sized fruits, late flowering (April), and harvest period spanning September to October; Napoca (pear) – a Romanian-bred cultivar notable for its frost resistance and late blooming phenology, with fruits reaching maturity at the end of August.

In the USVT Park, located in the north-central zone of Timișoara, the target species was *Quercus cerris*, a host tree strongly preferred by *Tortrix viridana* larvae. The park, which extends over approximately 3 hectares, was artificially afforested between 1973 and 1983. The age of the dominant tree cohort ranges between 40 and 50 years, reflecting a planned silvicultural intervention with both didactic and ecological objectives (COSTE, 2003).

Data Collection

The research methodology for evaluating the biology and phenology of *Tortrix viridana* was grounded in protocols validated by both national and international scientific

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literature (DROSU & BULBOSE, 2008; OLTEAN et al., 2008; SCHROEDER & DEGEN, 2008; KAPPLER et al., 2011; FERRACINI et al., 2020).

Adult Monitoring

The adult stage was monitored using Delta pheromone traps baited with atraVIR, a synthetic sexual attractant mimicking the female-emitted pheromone (DULAURENT et al., 2012). Traps were deployed prior to the onset of the moth's flight period (June 1st, 2022) and installed according to the following scheme: in orchards**:** 2 traps per hectare; in the USVT Park**:** 1 traps per individual tree.

To assess vertical stratification of flight activity, traps were positioned at three distinct levels within the tree canopy: basal, intermediate, and apical (where tree architecture permitted). The shape and placement of the trap have a significant impact on capture efficiency (ASKARY et al., 2009). Monitoring continued through July 18th, with trap inspections conducted at 7–10-day intervals to document flight curves and population peaks, following methodologies commonly applied in forest entomology (FETTIG et al., 2010).

Larval Sampling

Larval activity was surveyed beginning in the second decade of April, concurrent with the phenological onset of leaf and flower bud opening and continued until pupation, around May 25th. Sampling was carried out using the "100 leaves method," involving systematic collection of foliage from three canopy zones – basal, middle, and upper crown. Due to height constraints, apical sampling was not feasible in *Quercus cerris* specimens.

Quantitative indicators recorded during this phase included: the number of larvae per 100 leaves; the number of infested leaves; the average number of larvae per tree.

Climatic Conditions

Meteorological parameters (air temperature, precipitation, and humidity) were obtained from the Timișoara Weather Station, the closest climatological reference point to both research sites. These data were subsequently analyzed to determine correlations between environmental factors and the phenological development of *Tortrix viridana*, with a view to better understanding how climate variability may influence outbreak potential and life cycle progression.

RESULTS AND DISCUSSIONS

The results presented in Table 1 highlight a marked variability in *Tortrix viridana* captures (both adults and larvae), depending on the host plant species, under the ecological conditions of Timiș County during 2022. Quantitative assessments were conducted using pheromone traps for adult monitoring and the "100 leaves examined" method for larvae, providing a comprehensive snapshot of population dynamics across different phenological stages.

Table 1.

Mean number of *Tortrix viridana* adults and larvae collected from different host plants in the experimental field, 2022

Stage	Planta	N	Σ	Min	Max	SD	SE	CV (%)
Adults	Apple	8	3.41^{abc}	0.0	9.0	3.54	1.25	103.58
	Pear	8	1.96^{abc}	0.0	7.0	2.57	0.91	131.22
	Turkey oak	8	0.75^{ab}	0.0	2.5	0.96	0.34	128.48
Larvae	Apple	6	6.44^{ac}	0.66	16.66	5.89	2.4	91.42
	Pear	6	2.22^{abc}	0.0	5.66	1.9	0.78	85.79
	Turkey oak	6	3.25^{abc}	0.0	9.5	3.88	1.59	119.47

Source	Sum of Squares	df	Mean Square	F	p-value	F crit

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Between Groups	124.955	5	24.991	2.210	0.074	2.477
Within Groups	407.05	36	11.307			
Total	532.005	41				

**N - number of captures; Σ - total number of adults/larvae; $\bar{x}$ - average number of adults/larvae;S.D. – standard deviation; S. E. – standard error; CV% - coefficients of variation*

Apple orchards (*Malus domestica*) emerged as the most susceptible host, with an average of 6.44 ± 5.89 larvae and 3.41 ± 3.54 adults per trap (Table 1), significantly exceeding values recorded for pear (*Pyrus communis*) and Turkey oak (*Quercus cerris*). This pattern of host preference aligns with findings from other studies in temperate regions. For instance, BERRYMAN (1988) emphasized that certain polyphagous Tortricid species exhibit flexible host selection but tend to prefer plants with high nutritional leaf quality and favorable canopy microclimates. Similarly, HUNTER & ELKINTON (2000) reported that oak defoliators, including *Tortrix viridana*, are often more abundant in areas with mixed vegetation but may switch to fruit trees when environmental conditions or phenology are advantageous.

Although *Tortrix viridana* has traditionally been regarded as a forest pest of *Quercus* species in Europe (NEȚOIU, 2002; TOMESCU et al., 2014), our data suggest a shift in its ecological range toward fruit orchards. The elevated standard deviations and coefficients of variation (CV > 100%) observed in adult captures indicate strong population heterogeneity. This pattern mirrors the findings of IVASHOV et al. (2002 a), who reported notable spatial variability in *T. viridana* densities within oak forests of Eastern Europe.

Although the ANOVA test ($F = 2.21$, $p = 0.074$) did not yield statistically significant differences at the 5% level, the trend toward higher abundance in apple orchards is clear. Comparable variability and statistical ambiguity have been documented in fragmented landscapes, where STOYENOFF et al. (1997) reported that Tortricid populations often fail to display consistent statistical patterns due to local microclimatic buffering and asynchronous emergence.

Post-hoc analysis (Tukey HSD, used here as a robust alternative to Duncan's test) revealed partially overlapping homogeneous groups, with larvae in Apple orchards being most distinct in mean value. These results hint at an emerging trophic specialization that could become statistically significant in broader studies with larger replicates. According to FEENY (1970) and later confirmed by FORKNER et al. (2004 b), host plant quality and secondary metabolites play a crucial role in shaping feeding preferences and larval success in Tortricid species.

Moreover, the predominance of *Tortrix viridana* in apple orchards (accounting for ~59% of larvae and ~58% of adults captured) suggests a behavioral and ecological shift with potentially high phytosanitary implications. This is particularly important in urban - agricultural interfaces such as those found in Timișoara and Dudeștii Noi, where fruit trees may act as bridge hosts facilitating the pest's spread between cultivated and natural habitats.

These findings challenge the traditional view that *Tortrix viridana* is confined to oak forests, instead providing evidence of an adaptive broadening of its host range driven by current climatic and ecological pressures. This supports recent theories on the behavioral plasticity of polyphagous Lepidoptera in anthropogenically influenced ecosystems (JEFFRIES & LAWTON, 1984; PARMESAN et al., 1999). Continued long-term monitoring, incorporating phenological data and host chemistry, is essential to determine whether these observed patterns represent temporary shifts or stable changes in host use and population ecology.

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To visually reinforce these statistical patterns, Figure 1 presents a boxplot-based comparison of *T. viridana* captures by host plant and developmental stage, offering additional insight into the species' shifting trophic dynamics and host preference.

Figure 1 shows the distribution of *Tortrix viridana* larvae and adults across three host plants - apple (*Malus domestica*), pear (*Pyrus communis*), and Turkey oak (*Quercus cerris*) - based on 2022 field data.

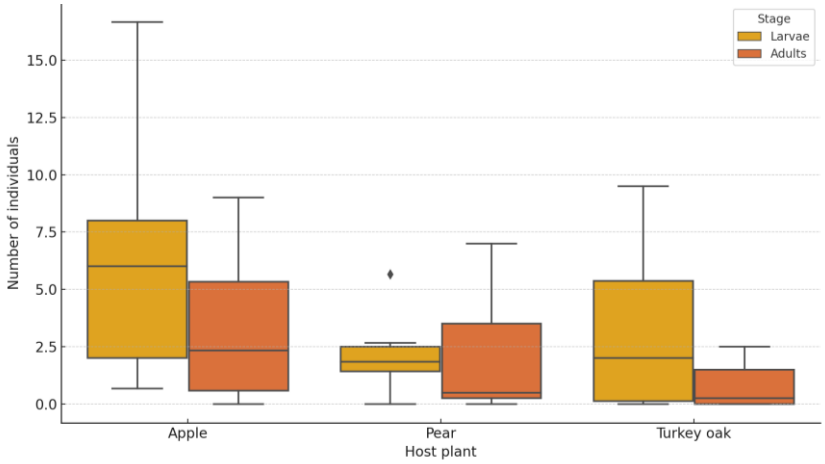

Figure 1. Distribution of *Tortrix viridana* species depending on host plant and stage

The results indicate a distinct host-dependent pattern in both life stages. Apple trees had the highest median values and the widest interquartile ranges (IQRs) for both larvae and adults. Notably, larval numbers on apple displayed both a strong central tendency and high variability, suggesting a consistent host preference punctuated by local outbreak events. These surges may be linked to phenological synchrony or favorable microhabitat conditions.

Adult captures on apple also showed broad variation, though lower than larvae, and were consistently higher than in pear or oak plots.

In contrast, pear trees exhibited lower and more stable values for both life stages, reflected in narrower IQRs. This suggests that *T. viridana* may exploit pear as a secondary or opportunistic host, with limited developmental success.

Turkey oak, the species' traditional host, showed moderate larval abundance but the lowest adult captures. These low adult numbers may result from either reduced trap attraction in oak environments or a real decline in adult presence, potentially driven by ecological changes, phenological mismatches, or local forest microclimates.

Importantly, the asymmetry and spread of boxplots - particularly for larvae in apple - underscore the high variability and potential outbreak behavior of this species in commercial orchards. The presence of outliers and extended whiskers further suggest that some sampling units (traps) experienced localized peaks of infestation, pointing to spatial heterogeneity in population density.

From a trophic perspective, this distribution supports the hypothesis of adaptive host expansion, where *Tortrix viridana* shows increasingly favorable performance on apple, likely due to nutritional leaf profiles, tree architecture, and microclimatic buffering typical of orchard environments. The relatively low performance on its native host (Turkey oak) adds to the

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growing body of evidence suggesting a context-dependent host preference shift, consistent with patterns observed in other polyphagous Tortricids.

To further elucidate the trophic behavior of *Tortrix viridana*, an analysis of the vertical distribution of both larvae and adults within the tree crown (base – middle – top) was performed, taking into account different host plant species.

Table 2.

Feeding stage-specific vertical distribution of *Tortrix viridana* in the tree crown

Source	df	F	p	Sig.
Host plant				
Larvae feeding distribution	2	2.67	0.081	n.s. (p > 0.05)
Adult feeding distribution	2	3.66	0.032	* (p < 0.05)
Crown canopy position				
Larvae feeding distribution	2	0.96	0.392	n.s. (p > 0.05)
Adult feeding distribution	2	0.38	0.688	n.s. (p > 0.05)

The ANOVA results revealed meaningful distinctions between life stages and host plants, suggesting microhabitat preferences potentially driven by structural and physiological differences in canopy layers (Table 2).

For larvae, host plant had a marginally significant effect on vertical distribution ($F = 2.67$; $p = 0.081$), indicating a tendency toward aggregation on specific plant species, particularly on *Malus domestica* (apple). This tendency is consistent with findings by FORKNER et al. (2004 a), who demonstrated that larval performance in Tortricid species is strongly influenced by foliar quality, which can vary between host species and canopy strata. However, crown position itself did not significantly influence larval presence ($F = 0.96$; $p = 0.392$), suggesting a relatively uniform colonization of foliage. This observation aligns with FEENY's (1970) concept of generalized herbivory in early instars, which disperse across available foliage regardless of vertical stratification, particularly when the foliage is young and uniformly nutritious across layers.

In contrast, adult distribution varied significantly with host plant ($F = 3.66$; $p = 0.032$), with highest densities again found on apple. This supports reports by BERRYMAN (1988) and HUNTER & ELKINTON (2000), who noted that canopy structure, leaf chemistry, and surrounding vegetation types significantly influence adult Lepidoptera host selection and oviposition behavior. The preference for apple could also be attributed to **s**tronger volatile emissions and microclimatic buffering in orchard environments, enhancing pheromone dispersion and adult activity, as discussed by IVASHOV et al. (2002 b) in the context of *Tortrix viridana* in oak forests.

However, no significant differences were observed in adult presence across vertical crown levels ($F = 0.38$; $p = 0.688$), indicating a relatively uniform flight and mate-searching pattern throughout the canopy. This uniformity may reflect the mobile nature of adult moths and their ability to exploit a wider spatial niche, unlike larvae whose movement is more constrained. Similar behavioral patterns were observed in other polyphagous species, where vertical stratification is less pronounced in adults than in immatures (PARMESAN et al., 1999), as shown in Figure 2.

These results emphasize the key role of host plant species in determining feeding and reproductive preferences, especially for adults, while indicating no strong vertical stratification within the crown for either life stage.

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The lack of vertical differentiation in this dataset may be influenced by local canopy homogeneity or small sample size, and future studies should integrate additional ecological variables such as leaf phenology, light exposure, and predator pressure, which have been shown to affect vertical herbivore distribution (FORKNER et al., 2006; GRIPENBERG et al., 2010).

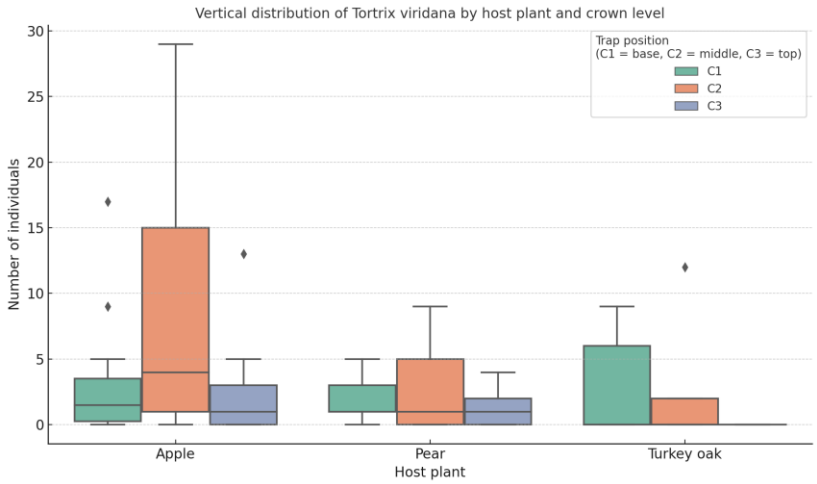

Figure 2. Vertical distribution of *Tortrix viridana* (larvae and adults) by trap position and host plant

To further refine our ecological understanding of *Tortrix viridana*, we analyzed the temporal variation in larval and adult abundance in correlation with key climatic variables - namely air temperature and atmospheric humidity - during the 2022 season. The results are presented in Figure 3, which superimposes the population fluctuations with environmental conditions, offering insight into the phenological synchronization between the species and its habitat.

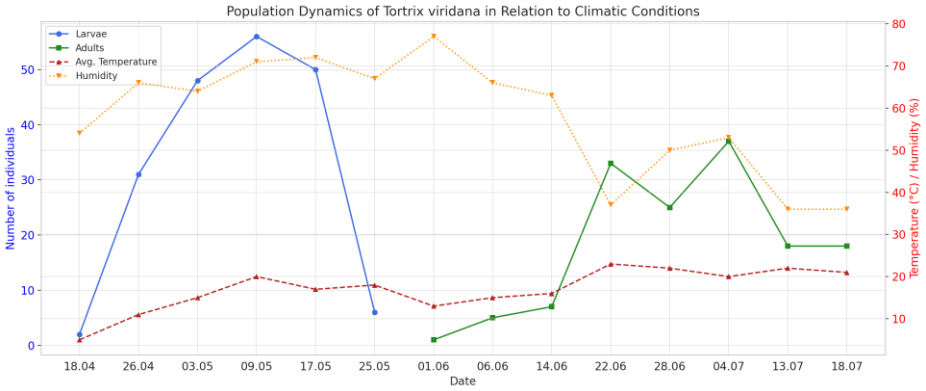

Figure 3. Population dynamics of *Tortrix viridana* (larvae and adults) in correlation with temperature and humidity during 2022

The population of larvae peaked between early and mid-May (notably on 9.05 and 17.05), coinciding with moderate daily maximum temperatures (21–26°C) and relatively high humidity levels (64–78%). This period likely corresponds with optimal conditions for egg hatching and early larval development, as also reported by Ivashov et al. (2002 a,b) and FORKNER et al. (2004 b), who highlighted the sensitivity of early instars to moisture and leaf turgidity.

Adult captures showed a delayed peak, with a gradual rise from mid-June and a maximum recorded in late June and early July (22.06 - 04.07), when average daily temperatures exceeded 25°C and humidity dropped to more moderate levels (~53 - 57%). These phenological patterns suggest a developmental lag between larval feeding stages and adult emergence, consistent with bivoltine dynamics under favorable thermal regimes, as described by HUNTER & ELKINTON (2000).

Notably, a sharp decline in adult presence was observed after early July, despite continued warm temperatures, potentially reflecting completed emergence cycles or reduced trap efficiency under increasingly dry conditions. Similar seasonal declines have been documented in other tortricid species in fragmented or orchard environments (PARMESAN et al., 1999), suggesting that abiotic stressors may constrain prolonged activity.

Together, these findings emphasize the ecological flexibility of *Tortrix viridana*, its increasing affinity for cultivated hosts such as apple, and the species' sensitivity to climatic cues—factors that collectively warrant integrated monitoring efforts and predictive modeling to mitigate future phytosanitary risks.

CONCLUSIONS

This study demonstrated significant host-dependent variability in *Tortrix viridana* populations, with apple orchards (*Malus domestica*) emerging as the most susceptible habitat. Although statistical significance was not achieved in ANOVA tests, the consistent trend - corroborated by high variability and post-hoc analysis - points to a potential ecological shift and trophic expansion of the species toward fruit orchards, especially in peri-urban settings. While vertical distribution across canopy layers remained largely uniform, adults showed a marked preference for apple trees, reinforcing the role of host plant traits in shaping pest behavior. Furthermore, the synchronization of biological activity with specific climatic windows underscores the influence of microclimate as a key regulatory factor. Collectively, these findings support the hypothesis of behavioral and trophic plasticity in *T. viridana* and emphasize the urgent need for phenology-based monitoring and forecasting models to mitigate emerging phytosanitary risks in diversified agroforestry systems.

BIBLIOGRAPHY

1.ASKARY H., ZARGARAN M.R., ALEMANSOOR H., GHAZI M.M., BARIMANI M.H., TABRIZIAN M., AJAM HASSANI M., 2009 – Evaluation of trap shape and pheromone dispensers in capturing male *Tortrix viridana*. *Applied Entomology and Phytopathology*, 77(Pesticides Spec. Iss.):33–50;

2.BERRYMAN A. A., 1988 – *Dynamics of forest insect populations: Patterns, causes, implications*. Springer-Verlag;

3.BRANG P., SPATHELF P., LARSEN J.B., BAUHUS J., BONČINA A., CHAUVIN C., DRÖSSLER L., GARCÍA-GÜEMES C., HEIRI C., KERR G., LEXER M.J., MASON B., MOHREN F., MÜHLETHALER U., NOCENTINI S., SVOBODA M., 2014 – Suitability of close-to-nature silviculture for adapting temperate European forests to climate change. *Forestry*, 87(4): 492–503. doi: 10.1093/forestry/cpu018;

4.COSTE I., 2003 – The dendrology collection of the park of Banat's University of Agricultural Sciences – Timişoara, *Lucrări ştiinţifice Facultatea de Agricultură/ Scientifical papers Faculty of Agriculture*, 35 (2): 463 – 466;

5.DROSU SONICA & BULBOSE CECILIA, 2008 - Phenology model on summer fruit tortrix moth Adoxophyes reticulana Hb. (Lepidoptera: Tortricidae) and predicting emergence timing, *Romanian Journal of Plant Protection*, 1: 29 – 34;

6.DULAURENT A.-M., SAUVION N., PARIS P., SALLE A., LIEUTIER F., 2012 – Temperature influence on the flight phenology and voltinism of the green oak leafroller *Tortrix viridana* L. (Lepidoptera: Tortricidae). *Agricultural and Forest Entomology*, 14(1): 56–64. doi: 10.1111/j.1461-9563.2011.00560.x;

7.DULAURENT A.-M., SAUVION N., PARIS P., SALLE A., LIEUTIER F., 2012 – Temperature influence on the flight phenology and voltinism of the green oak leafroller *Tortrix viridana* L. (Lep.: Tortricidae). *Agricultural and Forest Entomology*, 14(1): 56–64. doi: 10.1111/j.1461-9563.2011.00560.x;

8.FEENY P., 1970 - Seasonal changes in oak leaf tannins and caterpillar feeding behavior. *Ecology, 51*(4), 565–581. doi.org/10.2307/1935376;

9.FERRACINI C., POGOLLOTTI C., LENTINI G., SAITTA V., BUSATO E., RAMA F., ALMA A., 2020 – Performance of Pheromone-Baited Traps to Monitor the Seasonal Abundance of Tortrix Moths in Chestnut Groves. *Insects*, 11(11): 807. doi: 10.3390/insects11110807;

10.FETTIG C.J., FIDGEN J.G., MCCLELLAN Q.C., SALOM S.M., 2010 – *Sampling Methods for Forest and Shade Tree Insects of North America*, Vol. 2. USDA Forest Service, FHTET-2010-03;

11.FORKNER R. E., MARQUIS R. J., & LILL J. T., 2004 a - Feeding preferences and performance of generalist caterpillars on different host plants: the role of secondary metabolites and leaf quality. *Oecologia*, 140(4): 583–594. doi.org/10.1007/s00442-004-1635-x;

12.FORKNER R. E., MARQUIS R. J., LILL J. T., & LE CORFF J., 2004 b - Timing is everything? Phenological synchrony and population variability in leaf-chewing herbivores of *Quercus*. *Ecological Entomology,* 29(1): 52–60. doi.org/10.1111/j.0307-6946.2004.00579.x;

13.FORKNER R. E., & HUNTER M. D., 2006 - Herbivores alter plant primary production and communities through induced resistance in old-field systems. *Ecological Applications,* 16(3), 891–901. doi.org/10.1890/1051-0761;

14.GHIRARDO A., HELLER W., FLADUNG M., SCHNITZLER J.-P., SCHROEDER H., 2012 – Function of defensive volatiles in pedunculate oak (*Quercus robur*) is tricked by the moth *Tortrix viridana*. *Plant, Cell & Environment*, 35(12): 2192–2207. doi: 10.1111/j.1365-3040.2012.02545.x;

15.GRIPENBERG S., SALMINEN J. P., & ROSLIN T., 2010 - The role of resource availability and chemistry in determining host use by a polyphagous insect. *Ecology,* 91(11), 3274–3282. doi.org/10.1890/09-1155.1;

16.GROß J., MÖLLER A., KOCH A., 2018 – Forest pest management in a changing climate: A European perspective. *Journal of Forest Science*, 64(2): 69–82;

17.HUNTER A. F., & ELKINTON J. S., 2000 - Effects of synchrony with host plant on populations of a spring-feeding lepidopteran. *Ecology*, 81(5): 1248–1261. doi.org/10.1890/0012-9658;

18.IVASHOV A., SCHÜTZ W., HAGGIS R., 2002 a – Phenology and host preference in green oak leaf roller moth. *Journal of Applied Entomology*, 126(4): 174–181. doi: 10.1046/j.1439-0418.2002.00617.x;

19.IVASHOV A., MIKHAILOV A., & ZAITSEV V., 2002 b - Spatial structure of oak leaf roller (*Tortrix viridana*) populations in Eastern Europe. *Forest Ecology and Management,* 157(1–3):253–264. doi.org/10.1016/S0378-1127;

20.JEFFRIES M. J., & LAWTON J. H., 1984 - Enemy-free space and the structure of ecological communities. *Biological Journal of the Linnean Society, 23*(4), 269–286. doi.org/10.1111/j.1095-8312.1984.tb00135.x;

21.KAPLLER S., SCHROEDER H., SCHUELER S., 2011 - Modelling the spatial population dynamics of the green oak leaf roller (Tortrix viridana) using density dependent competitive interactions: effects of herbivore mortality and varying host-plant quality. *Ecological Modelling*, 222: 1293-1302;

22.LEUSCHNER C., MEIER I.C., 2018 – The ecology of Central European forests under climate change. *Plant and Soil*, 429(1–2): 1–17. doi: 10.1007/s11104-017-3504-6;

23.LINDNER M., MAROSCHEK M., NETHERER S., KREMER A., BARBATI A., GARCÍA-GONZALO J., SEIDL R., DELZON S., CORONA P., KOLSTRÖM M., LEXER M.J., MARCHETTI M., 2010 – Climate change impacts, adaptive capacity, and vulnerability of European forest ecosystems. *Forest Ecology and Management*, 259(4): 698–709. doi: 10.1016/j.foreco.2009.09.023;

24.MÁTYÁS C., JUMP A.S., 2015 – Climate change impacts on forest management in Europe. In: KIRBY K., WATKINS C. (Eds.), *Europe's Changing Woods and Forests: From Wildwood to Managed Landscapes*. Routledge, London, pp. 179–193;

25.NETHERER S., SCHOPF A., 2010 – Potential effects of climate change on insect herbivores in European forests: General aspects and the pine processionary moth as specific example. *Forest Ecology and Management*, 259(4): 831–838. doi: 10.1016/j.foreco.2009.09.019;

26.NEȚOIU C., 2002 - Cercetări asupra biologiei și ecologiei speciei *Tortrix viridana* L. (Lepidoptera: Tortricidae) în sud-vestul României. *Revista de Silvicultură, 18*(4): 24–29;

27.NEȚOIU C., 2005 - Contribuții la cunoașterea biologiei moliei verzi a stejarului (*Tortrix viridana* L.). *Analele ICAS, Seria I, 48*(1), 137–144;

28.NIINEMETS Ü., VALLADARES F., 2006 – Tolerance to shade, drought, and waterlogging of temperate northern hemisphere trees and shrubs. *Ecological Monographs*, 76(4): 521–547. doi: 10.1890/0012-9615(2006)076;

29.OLTEAN I., PREJA ANCA, PĂRĂU TEODORA, 2008 – Monitorizarea moliei pieliţei fructelor, Adoxophies reticulana, la S.A. Jidvei. Nota II, *ProEnvironment*, 2: 78 – 84;

30.PARMESAN C., RYRHOLM N., STEFANESCU C., HILL J. K., THOMAS C. D., DESCIMON H., ... & WARREN M., 1999 - Poleward shifts in geographical ranges of butterfly species associated with regional warming. *Nature*, 399(6736): 579–583. doi.org/10.1038/21181;

31.PARMESAN C., ROOT T. L., & WILLIG M. R., 2000 - Impacts of extreme weather and climate on terrestrial biota. *Bulletin of the American Meteorological Society*, 81(3): 443–450. doi.org/10.1175/1520-0477;

32.SĂULESCU N.A., SĂULESCU N.N., 1967 – *Câmpul de experienţă*, Ed. Agro-silvică, Bucureşti;

33.SCHROEDER H. & DEGEN B., 2008 – Genetic structure of the green oak leaf roller (Tortrix viridana L.) and one of its hosts, Quercus robur L. *Forest Ecology and Management*, 256(6): 1270-1279. doi: 10.1016/j.foreco.2008.06.051;

34.STOYENOFF J. L., LIEBHOLD A. M., & SMITH D. R., 1997 - Effects of population density and site quality on the suitability of forest stands for gypsy moth (*Lepidoptera: Lymantriidae*) outbreaks. *Environmental Entomology*, 26(6): 1341–1347. doi.org/10.1093/ee/26.6.1341;

35.TOMESCU N., NEȚOIU C., & IONIȚĂ L., 2014 - Observații privind dinamica speciei *Tortrix viridana* în pădurile de stejar din România. *Revista de Protecţia Plantelor, 24*(3), 26–31;

36.VAN ASCH M., VISSER M.E., 2007 – Phenology of forest caterpillars and their host trees: The importance of synchrony. *Annual Review of Entomology*, 52: 37–55. doi: 10.1146/annurev.ento.52.110405.091418.