Stink bugs, pear scale and medfly: Distribution maps of invasive fruit pests in Germany

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Abstract

Invasive pest insects are a growing problem because of climate change and global trade. Some of the most important climate sensitive pest insects of fruits and soft fruits in Germany are in focus of the federal monitoring project ProgRAMM including realtime mapping of their distribution. The Brown marmorated stink bug Halyomorpha halys has been recorded in Germany since 2011 and has already spread in the upper Rhine valley, and to several larger cities. The Southern green stink bug Nezara viridula has been recorded since 1979. This species has been "activated" by climate change due to moderate winter conditions and causes at least as much damage as H. halys, especially in soft fruit (blackberries and raspberries). The European pear scale Epidiaspis leperii is distributed along the Southern Rhine valley for 150 years. It causes major damages in peach and pear in Rhineland-Palatinate in the last years and has already been transported to the North-East of Germany. The Mediterranean fruit fly Ceratitis capitata is occurring regularly in Germany, e.g. with local damages in peach in the area of Lake Constance. Yet it is unknown if this fruit fly species is able to survive overwintering conditions in Germany.

Keywords: ProgRAMM, *Nezara viridula*, *Halyomorpha halys*, *Epidiaspis leperii*, *Ceratitis capitata*

Introduction

The German federal project "ProgRAMM" aims to optimize current pest risk analysis data (PRAs) of potentially invasive pest species. The project is a cooperation between the Julius Kuehn-Institute (JKI), the Potsdam Institute for Climate Impact Research (PIK) and the Agricultural Research Center Augustenberg (LTZ) in Karlsruhe (Heß et al. 2019). Invasive pest insects are a growing problem in fruits and soft fruits. Especially in the Upper Rhine Valley where most of them are occurring for the first time in Germany.

Environmental changes include shorter frost periods, warmer winter conditions and heat stress in the summer seasons (LUBW 2017). Neozoic species show a better adaptation to these conditions, even endemic species might react with a higher number of generations per year, changes in frass activity and adaptation to attacking heat stress damaged plants.

These changes will force the federal plant protection services as well as private plant protection advisers to react and to develop new plant protection strategies. Online distribution maps of the ProgRAMM-project and prognosis models for the invasive pest insects in fruits and soft fruit may support both, producers and advisors.

The selected pest species are the Southern green stink bug *Nezara viridula*, the Brown marmorated stink bug *Halyomorpha halys*, the Mediterranean fruit fly *Ceratitis capitata* and the European pear scale *Epidiaspis leperii* (Reißig & Zimmermann 2019). They show different distribution patterns and are the most important climate sensitive species in fruit orchards and soft fruit productions.

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Material and Methods

Mapping pest insects is based on historical and current distribution data. Data collection includes interviewing plant protection advisors, plant protection services and entomologists in “hot spot regions” for each pest species for a time-saving “focused monitoring” strategy. Other data sources are data sets of citizen science smartphone applications and reviewing publications. These monitoring data are being displayed in graphical form using the internet mapping software ArcGIS-Portal by the plant protection information system ISIP (www.isip.de 2019). Current data collection can be realized by an internet application (ArcGIS-Collector) and the distribution maps are being displayed in realtime on any internet-website using the specific embed codes.

Monitoring methods are different for each of the four insect species. Principally visual monitoring is the key method, e.g. to detect the mating of stink bugs and oviposition or the hatching of pear scale crawlers. Specific trapping is possible for *H. halys* and *C. capitata*. *E. leperii* has to be detected by scratching the branches surface of e.g. of pear and plum since this scale insect is hiding under green algae covering. *N. viridula* can only be observed visually. Test pheromones are not yet working for monitoring this bug species.

Results: Distribution data.

Table 1: Biological data and monitoring parameters of selected invasive fruit pest insects.

	Halyomorpha halys	***Nezara viridula***	***Ceratitis capitata***	***Epidiaspis leperii***
first record in Germany	2011 (Konstanz)	1979 (Cologne)	1930	circa 1870 (South Rhine valley)
“activation”	2016/2017	2015/2016	not known	2008
distribution pattern	traffic!, natural flight	traffic?, natural flight	infested traded fruit, natural flight	infested plant material
number of generations	1(-2)	(1-)2	up to 16 ?	1
hibernation (dev. stage)	yes (adult)	yes (adult)	not clear	yes (female)
current distribution	Rhine valley, larger cities	Rhine valley, larger cities	south and northeast	Rhine valley
spreading risk	very high	high	moderate	low
distribution data availability	very good	very good	medium	bad
host plants	> 300 (e. g. pear, apple, beans, soy, tomato, sweet pepper, eggplant, cucumber, cherry laurel, maize, grapes, herbs)	> 300 (e. g. beans, soy, tomato, sweet pepper, eggplant, cucumber, maize, herbs, sunflower, ornamental plants)	apricot, peach, citrus, apple	mirabelle plum, pear, plum
specific antagonists (present in Europe)	*Trissolcus japonicus*, *T. mitsukurii*	*Trissolcus basalis, Trichopoda pennipes*	not really known	several parasitoid and predatory species

Figure 1: Distribution map of *Halyomorpha halys*

Figure 2: Distribution map of *Nezara viridula*

Figure 3: Distribution map of *Ceratitis capitate*

Figure 4: Distribution map of *Epidiaspis leperii*

Conclusion

The first data sets of this project show the importance of monitoring invasive species. Especially the documentation of the very fast spread of the Brown marmorated stink bug and its severe damages in South Tyrol and Switzerland indicate the high risk for plant health in German fruit growing. Due to climate change risks assessments for invasive species have to be adjusted dynamically to be prepared for future plant protection strategies. It is planned to assess new data sets and mappings for modeling climate sensitive species continuously for early detection of potentially invasive pest species.

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