CZU: 634.8:632.7:59.08(477) https://doi.org/10.53040/ppap2023.68

PREDICTION OF THE NUMBERS OF *LOBESIA BOTRANA* SCHIFF. ON VINEYARD PLANTATIONS OF SOUTHERN UKRAINE

KLECHKOVSKYI Yu.*, SHMATKOVSKA Katerina**

Quarantine station of grape and fruit cultures of Institute of plant protection of NAAS, Odesa, Ukraine

**https://orcid.org/0000-0003-4404-5553,*

*** https://orcid.org/0000-0002-3884-7595,*

e-mail: oskvpk@te.net.ua, k.shmatkovskaia@gmail.com

Summary. Data on the number of European grapevine moth in the vineyards of the south of Ukraine as a function of abiotic factors: average daily air temperature, amount of precipitation, relative air humidity are given. Based on these data, using the correlation-regression method, mathematical models for the prediction of phytophagous development were developed, which will allow to optimize the frequency and timeliness of protective measures in the fight against this pest.

Keywords: *Lobesia botrana, pest monitoring, pest numbers, predictive models*

Introduction. Integrated plant protection in the modern sense involves the management of populations of harmful organisms within specific agrobiocenoses using a system of measures optimal for specific conditions. The main prerequisite for integrated plant protection is phytosanitary monitoring and forecasting the number of harmful organisms. The forecast is the basis for planning and developing modern systems of integrated protection of agricultural crops from a complex of pests and diseases, calculating the need for chemical, biological and other means of plant protection [1-3].

Three types of leaf curlers are found on vineyards in southern Ukraine - biennial (*Eupoecilia ambiquella* Hb.), vine moth (*Lobesia botrana* Schiff.) and grape (*Sparganothis pilleriana* Den. et Schiff.). Among them, *European grapevine moth* is particularly aggressive, annually causing significant damage to this culture all over the world. With a large number of polyphages and the absence of protective measures, crop losses amount to 60-80%, and in some cases the pest can destroy the entire crop [4-8]. The pest control strategy is based on monitoring the population, number and intensity of reproduction, which makes it possible to determine the area of settlement, the level of its harmfulness and plan the need for plant protection products both in individual regions (regions) and in the country as a whole. Analyzing the information obtained in previous years, it is possible to develop mathematical models of the forecast of the number of pests, which allow with high reliability to trace the dependence of the dynamics of the number of pests on the abiotic factors of the environment, and are the main criteria in their development. Therefore, the aim of the work is to forecast the number of *Lobesia botrana* depending on the complex of environmental factors and to develop mathematical models for forecasting the number and development of generations in the research region.

Materials and methods. In 2016–2022 monitored the number of *European grapevine moth* on grape plantations in southern Ukraine according to generally accepted methods [9]. Mathematical models for the prediction of phytophagous numbers were developed using the correlation-regression method [10].

Results and discussions. The development of prognostic models is an actual method used to improve the system of protection of plantations against diseases and pests. Outside of Ukraine, in recent years, models and computer programs have been developed that allow forecasting the development of agricultural crops and signaling the need for the use of pesticides. The creation of such programs requires a significant amount of data on the number and development of the pest in a separate region over a long period. For example, one of these computer models is the Bugoff G program, developed in the USA and applied in Germany; in England, a program complex was used PAST MAN [1,11,12].

In Ukraine, there is an urgent need for the introduction of new methods of processing and analysis of the received information, which should be based on the modeling of the researched processes using modern mathematical forecasting methods.

The main predictors for the model were selected taking into account literature data and own observations of the biology of the pest on the vineyards of southern Ukraine. A high dependence of the seasonal dynamics of the number of each generation of the *Lobesia botrana* Den. et Schiff. on both the average daily temperature and the increase in relative air humidity was observed (Table 1).

Table.1 Actual and projected numbers of *Lobesia botrana* Den. et Schiff. in the conditions of southern Ukraine (2018-2022). According to weather station No. 33837 (latitude - 46.4°, longitude - 30.8°), Odessa, Ukraine

Years	Indicators (for the period of research)											
	Number of butterflies, copies/trap									Among t air, °C	Amount of precipitation, (mm)	Average relative humidity,%
	I generation			II generation			III generation					
	Φ	$У_1$	$У\text{-}У_1$	Φ	$У_2$	$У\text{-}У_2$	Φ	$У_3$	$У\text{-}У_3$	X_1	X_2	X_3
2016	92	84	8	83	90	-7	37	37	0	17,8	394,4	75
2017	135	123	12	75	68	7	31	31	0	17,2	277,9	69
2018	95	100	-5	79	67	12	28	29	-1	17,8	348,0	67
2019	146	156	-10	60	60	0	25	27	-2	18,1	182,6	64
2020	183	168	15	58	50	8	21	24	-3	17,5	147,8	62
2021	93	102	-9	32	36	-4	20	20	0	16,2	333,5	61
2022	137	148	-11	40	55	-15	30	25	5	17,8	204,8	63

Φ – is the actual number of the pest, sample/trap;

$У_{1,2,3}$ – predicted number of pests, samples/trap;

$У\text{-}У_{1,2,3}$ – deviation from the actual quantity;

The model developed by us reliably with a multiple correlation coefficient of 0.94, 0.86, 0.91 allows us to predict the number and development of three generations of the pest in the conditions of the Odesa region.

Mathematical models of population forecasting *Lobesia botrana*

У1= 196,436+1,252•X1 - 0,343•X2,

У2= - 274,643+8,088•X1 + 2,952•X3,

У3= -70,870+1,838•X1 + 1,004•X3,

де: У1 – predicted number of grapevine moth of the 1st generation in the current year, copies/trap;

У2 – predicted number of 2nd generation grapevine moth in the current year, copies/trap;

У3 – predicted number of 3rd generation grapevine moth in the current year, copies/trap;

X1 – index of average daily air temperature, °C;

X2 – indicator of the amount of precipitation, mm;

X3 – indicator of relative air humidity, %.

196,436, - 274,643, -70,870 - free coefficient;

Actual and estimated numbers with high indicators and reliability are displayed in graphs (Figure 1).

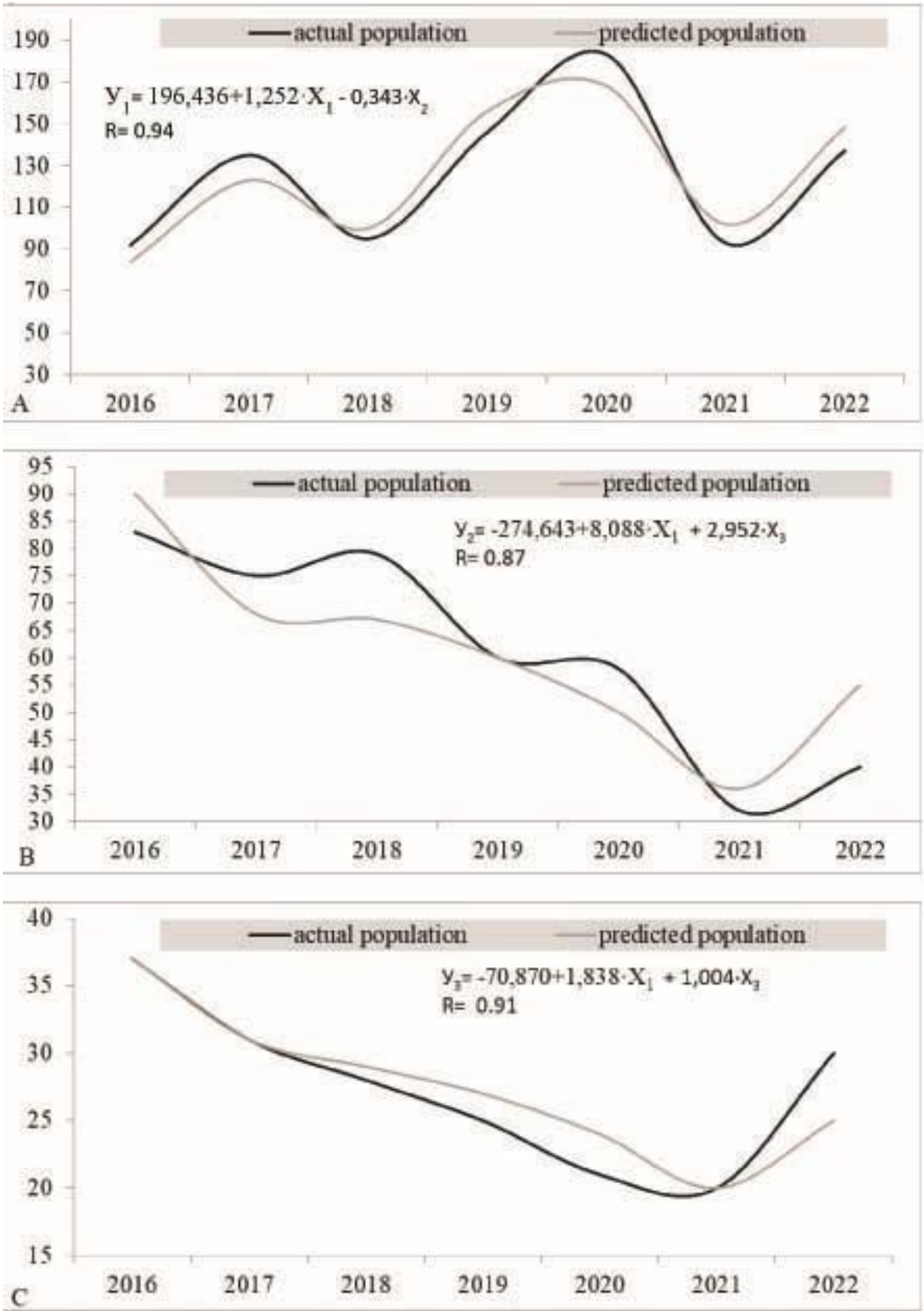

Figure 1. *Lobesia botrana* population dynamics in Odesa region, A - I generation, B - II generation, C - III generation (2018 - 2022)

Conclusions. The described correlations, as well as the compiled mathematical models of modern forecasting, make it possible to predict the settlement of grape plantations by *Lobesia botrana* Den. et Schiff., to optimize the frequency and timeliness of protective measures against it in the conditions of southern Ukraine.

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