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ONTOGENETIC AND POPULATION STRUCTURE OF ALIEN SPECIES

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Досліджено онтогенетично-популяційну структуру адвентивних видів рослин в агроценозах зернових Правобережного Лісостепу. Наведено оцінку сегетального потенціалу трьох видів: Sonchus arvensis L., Iva xanthifolia L., Xanthium strumarium L., які за віковою структурою, показниками рясності та частотою трапляння визначено як модельні. За індексами «дельта-омега» встановлено, що досліджувані види відносяться до молодих, перехідних та зріючих популяцій. За результатами аналізу встановлено, що популяції модельних видів у агроценозах представлено різними віковими станами. Це свідчить про те, що вони є стійкими та здатними до самопідтримки своєї чисельності за відсутності спеціальних заходів контролю.

Ключові слова: *агроценоз, популяція, енергетичне навантаження, адвентивний вид, інвазійність.*

Studying of ontogenesis features and structure of coenopopulations allows us to speak about prosperity or inhibition of a particular species in a concrete habit area. To determine a potential of stranger species, this indicator is of great importance [4].

The ability of adventitious species to spread in agrocenoses and in natural phytocenoses and in this way create local populations that are adapted to abiotic, biotic and anthropogenic factors and also to the growth conditions, is of great interest for theoretical ecology. Stranger species that in the process of adaptation to the new conditions of existence received the ability to create local populations of wide age spectrum has significant advantages over the species of narrow ontogenetical amplitude [11].

Today adventitious plant species is a subject of an acute ecological monitoring and control of their number because they cause «floral contamination of the territory», which can lead to decreassing of biodiversity. And the losses that cause weed-grown species in agriculture are equal to damages from pests, diseases and others, according to numerous evidences of authors [1, 2, 5, 14, 15].

However, questions still remain actual towards the studying of the structure, composition, dynamics and adaptation possibilities of plant populations of invasive species of plants which distribution area increases from year to year [7].

Considering the above mentioned, we had a task to investigate an ontogenetic and populational structure of adventive plant species in agrocenoses.

MATERIALS AND METHODS

The researches were carried out in agrocenoses of field crops in private farms on the territory of Odessa and Vinnytsia regions that specialize in the production of plant products. The detailed route examinations of agrocenosis in the phase of growing season of crops were conducted.

In the structure of sowing areas of the region in order to conduct researches we involved agrocenoses of main crops such as winter wheat, winter barley, corn for grain.

We studied the species composition of adventitious plant species in agrocenoses through the field descriptions. Censuring of plants was conducted on the five accounting plots areas, the square of each one reached 1 m^2. The frequency of plant species occurrence in agrocenoses we determined using the scale by the method of Ye. Liubarskyi [4]. Species abundance was determined by the method of M. Komarov [5]. Projective cover was defined visually. According to the methodology of O.O. Uranov we determined an age (age-related) index of population Δ, whereas L. Zhyvotovskyi suggested using an efficiency index of population ω as an energy load on environment that makes an average plant in fractions from plants energy efficiency of mature generative condition of given population.

The assessment of the population state we carried out on the basis of the ratio of Δ (age (age-related) index of population) — ω (efficiency index of population) (delta-omega), and also we defined the physical density of population, which is expressed as amount of the individuals number of different age conditions per unit area (M) and effective density of population — the sum of all plants efficiencies per unit area (M_e). Based on this L. Zhyvotovskyi identified six types of populations: young, transitional, maturing, adult, grow old, olden [3]. According to this typification we made an assessment of adventive plant species.

RESULTS AND DISCUSSION

In result of conducted researches and analysis of the literature data it was found the threat for agrocenoses of the following weed species: *Sonchus arvensis* L., *Iva xanthifolia* L., *Xanthium strumarium* L. These species belong to «the most widespread» weeds that grow in Ukraine now almost everywhere on the fields, pastures, along roadsides. Chosen by us plants anthropophytes are characterized by a high grade of frequency and abundance and distributed in almost all agrocenoses. Thus, having studied their energy load on the environmental resources, in our case their influence on agrocenosis of field crops, let's extrapolate the received data to the other territories where these species have not been spread.

It should also be noted that these species cause a considerable damage to agricultural crops. For example, crop losses from *Iva xanthifolia* weediness could vary from 25 to 30%,

and in some cases up to 50% [1]. With strong weediness with canada thistle (*Sonchus arvensis* L.) there is a significant loss of crop yield. Thus, in the sowings of spring or winter wheat harvest losses could reach up to 45%; barley up to 73%; oats up to 45%; and rape up to 60%.

That is why we used the classification of «delta-omega», which is based on the indexes assessments (Δ and ω), obtained according to the age distribution of all individuals of population, begining from crop appearing and ending with the massive flowering and fruiting (Table 1).

Research results of *Sonchus arvensis*, *Xanthium strumarium*, *Iva xanthifolia* populations according of their energy load (ratio of physical and effective density) shows that diffe-

Table 1

The energy load and age structure of stranger species populations of *Sonchus arvensis* L., *Iva xanthifolia* L., *Xanthium strumarium* L., and cultivated plants in agrocenoses

Species	Age status	$*n_i=M$	n	$p_i=n_i/n$	e_i	m_i	$w=p_ie_i$	$\Delta= p_im_i$	$M_e=wM$
Sonchus arvensis L.	j	10	50	0.2	0.071	0.018	0.014	0.004	0.141
	im	17	50	0.340	0,181	0.474	0.061	0.161	1.044
	v	23	50	0.460	0,420	0.119	0.193	0.055	4.444
Triticum aestivum L.	g^3	820	820	1	0,7864	0.7311	0.7864	0.7311	644.8
Sonchus arvensis L.	im	14	25	0.560	0,181	0.474	0.101	0.265	1.417
	g^2	11	25	0.440	1,000	0.500	0.440	0.220	4.840
Zae mays L.	g^2	120	120	1	1	0.5	1	0.5	120
Iva xanthifolia L.	j	13	59	0.220339	0,0707	0.018	0.016	0.004	0.202514
	im	20	59	0.338983	0,1807	0.474	0.061	0.161	1.225085
	v	12	59	0.20339	0,42	0.1192	0.085	0.024	1.025085
	g^1	14	59	0.237288	0,7864	0.2689	0.187	0.064	2.612447
Zae mays L.	g^3	98	98	1	0,7864	0.7311	0.7864	0.7311	77.1
Iva xanthifolia L.	v	18	30	0.6	0,42	0.1192	0.252	0.072	4.536
	g^2	12	30	0.4	1	0.5	0.400	0.200	4.8
Hordéum vulgáre L.	g^3	900	900	1	0,7864	0.7311	0.7864	0.7311	707.7
Xantium strumarium L.	j	9	36	0.25	0,0707	0.018	0.018	0.005	0.159075
	im	12	36	0.333333	0,1807	0.474	0.060	0.158	0.7228
	v	8	36	0.222222	0,42	0.1192	0.093	0.026	0746667
	g^2	7	36	0.194444	1	0.5	0.194	0.097	1.361111
Triticum aestivum L.	g^2	850	850	1	1	0.5	1	0.5	850
Xantium strumarium L.	j	8	17	0.470588	0,0707	0.018	0.033	0.008	0.266165
	im	9	17	0.529412	0,1807	0.474	0.096	0.251	0.860982
Zae mays L.	g^3	103	103	1	0,7864	0.7311	0.7864	0.7311	80.1

Note: n_i — the number of individuals per unit of area (1 m^2) or natural population density (M); n — total population of individuals; p_i — share of individuals of i state in this population, e_i — effectiveness of individuals; m_i — age of population; Δ — age of population index; w — population effectiveness index; M_e — effective density of population.

rence between indicators of these population species is significant. Index of efficiency and age (age-related) index of *Sonchus arvensis* populations in the sowings of winter wheat were: 0.26 and 0.22; in the sowings of corn on grain — respectively 0.54 and 0.47; *Iva xanthifolia* population indexes in corn crops were 0.4 and 0.25, in the sowings of winter barley — 0.65 and 0.27. Indexes of *Xanthium strumarium* population in the sowings of winter wheat and corn on grain were respectively ω — 0.36 та Δ — 0.28, ω — 0.2 та Δ — 0.26. We found that researched populations of adventitious plant belong mainly to the young and transitional ones, and it proves that population species are immature and capable for further expansion.

It is known that various age conditions of one and the same species have different impact on both cultivated plant and other species in the grouping. When assessing the negative impact of model species it is important along with species diversity, occurance and density of populations (abundance) to know about a spectrum of their age ontogenetic states. L. Zhyvotovskyi proposed to determine the energy efficiency of a particular population [3].

In the process of agrocenoses descriptions, it was determined that in the vertical structure of the agrophytocenoses model species population occupied middle and lower tiers at the moment of descriptions. The dominants of the first tier were cultivated plants. It should be noted that in the studied agrocenopopulations *Sonchus arvensis* age states of beforegenerative and generative stages were presented. In agrocenopopulations *Iva xanthifolia* also we marked appearing, imature, virginal and generative states of adventitious plant species. In other words, during the earing period of spiked cereals the energetic load of agrocenopopulations of adventitious species is determined primarily by beforegenerative and in some cases by generative individuals.

CONCLUSIONS

In sowing of cereals model stranger species (*Xantium strumarium*, *Iva xanthifolia*, *Sonchus arvensis*) selected for studying do not have a significant effect on yield formation because the energy load of their populations on agrocenosis in comparison with cultivated plants is very small. At the same time the ontogenetic structure of agricultural cenopopulations of all three species is the evidence of high segetal potential. After the mowing cultivated plants, individuals of weeds located on the middle and lower tier are able to complete the ontogenesis with high seed productivity that will ensure future viability of weed groupings in the next growing season.

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