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METHODOLOGY OF DETERMINATION FOR ALLOWANCE INDICATORS OF WEEDINESS LEVEL OF AGRICULTURAL CROPS FOR ITS EFFECTIVE CONTROL

The analysis of methodology of determination for indicators of economic and ecological-economic weediness thresholds of agricultural crops. Proposed a mathematical model of function for calculating the value of the allowance, amount of reproductive weeds and prognosis of its expected value as methodological providing of control, crops weediness.
Keywords: *amount, allowance, allowance, reproductive weeds, prediction of weediness, control*

Introduction. The modern concept of effectively protection tactics of agricultural crops from weeds involves achievement of certain acceptable level of their weediness that is appropriate for requirements of the business, economic and environmental efficiency. This concept was called the weediness control.

Its implementation in practical herbology requires information on the normative allowable values of parameters relevant features of agrophytocenoses that would become reference points for technological decision and evaluation of their ability for effective control.

To establish economically effective control measures from weeds such allowance serves as a saved value of crop yield (Ys) due to its application [1]:

$$Ys = C/P, \text{ t/ha}$$

where C - Costs of application control measures,

P - the realizable price of primary products UAH/ha yield, UAH/t.

If actual or expected productivity increasing in yield from application of the measure or system of the measures is equal to the calculated allowance, that its application is economically efficient.

For the establishment of the cost-effective weed control measures proposed economic thresholds of harmfulness (ETH), logical unit of which must be saved yield cost, UAH/ha, which measure the harm caused by weeds:

$$ETH = Ys*P, \text{ UAH/ha}$$

where Ys - the value of saved yield, t/ha

P - the realizable price of primary yield products, UAH/t.

Cost- effective measure will be weeds control, that the cost of application does not exceed the value ETH. Obviously logically untenable looks admission called "economic threshold of harmfulness of weeds", measured amount, pcs./m^2 or mass of weeds g/m^2 , which however are used in herbology [2]. The failure of this is the inadequacy between concepts attached figure and its unit of measurement. Rather, the value measured amount or mass of weeds, called the economic threshold or weediness (ETW). The content of this concept is expressed amount (weight) of weeds which causes loss of crops yield that equal of costs of their destruction:

$$ETW = Yl*P/H; \text{ pcs./m}^2,$$

where Y1 - the value of yield losses, t/ha

P - the realizable price of primary yield products, UAH/t

H - harmfulness of weeds, expressed in yield losses caused by their constant presence in crops during the growing season of amount 1 pcs./m^2 or weight (1 g/m^2).

Later, it was proposed criteria for allowance of weediness, called "eco-economic threshold" (EET), which differs from the economic (ETW) environmental constraints imposed by allowable rate and frequency of application of materiel weeds control, including herbicides [3]:

$$EET = C*(100 + P)*Cor/H*P*S, \text{ pcs./m}^2$$

Where C - Costs of application measure, UAH/ha

P-planned profitability of products, %

H - weeds harmfulness according to background information expressed loss of yield t/ha, due to the amount of weeds 1 pcs./m^2

P - realizable price of products, UAH/t

S - normative survival of weeds in crops of a particular crop on a background of growing technology but without the use of research activities, such as herbicide.

Worth attention also own herbologically criteria of allowance of reproductive amountof weeds in crops, which regulating its value, does not lead to an increase in potential weediness of crops. Having all these allowance of weediness crop suggests its reasonable control, when it meets the criteria of economic, environmental performance, and does not allow an increase in the potential weediness of arable land causes actual crops weediness. Definition for allowance of reproductive weeds in crops now don't has a methodological support, which was the motivation for this publication.

The purpose of the research selected development methodology for determining for allowance amount of reproductive weeds in agricultural crops.

Materials and methods. For achievement of the purpose used methods of field experiments, modeling, calculation. In a stationary two-factor field experiment with variants primary soil tillage and herbicide application in zone rotation during 1981-2001 in conditions of Agronomy Research Station NULES Ukraine conducted monitoring of seed productivity of common weed species.

The value of seed productivity of one weed species, expressed in thousands of pieces calculated by dividing the weight seed collected from 20-50 plants placed evenly along two diagonals experimental areas on the mass one thousand seeds and number of plants [4]. This experiment also conducted long-term monitoring of potential changes in the value and actual weediness of arable land.

The potential weediness of arable land determined mechanically [5] separating weed seeds from soil samples on sieves with holes with diameter of 0.25 mm.

Actually weediness determined by the amount of weeds and plant aboveground mass quantitative and quantitative gravimetric method [6] in a stationary field experiment with variants farming systems and soil tillage (Table 3).

Results and discussion. Information to determine of values of seed productivity of basic 33 weed species displayed in Table 1.

Table 1

Average value of seed productivity of one plant species of weeds in crops production technological groups of crops, thousand pcs seeds (average for 2002-2007)

Biological groups and types of weeds	Technology group of crops	
	row-crop	not row-crop
Spring species averaged	40	4
Ambrosia artemisifolia L.	10	1
Galinsoga parviflora Cav.	30	3
Polygonum convolvulus L	10	1
Sinapis arvensis L.	3	0,3
Polygonum tatarikum L	1	0,1
Echinocloa crus- galli L.	6	0,6
Brassica arvensis L.	2	0,2
Chenopodium album L	70	7
Avena fatua L	1	0,1
Solanum nigrum L	30	3
Raphanus raphanistrum L	10	1
Setaria glauca L	1	0,1

Amaranthus retroflexus L	100	10
Winter types	2	0,2
Apera spica- venti L	2	0,2
Wintering species averaged	2	0,2
Centaurea cyanus L	6	0,6
Descurainia Sophia L	85	8,5
Delphinium consolida L	7	0,7
Stellaria media L	2	0,2
Erigeron canadensis L	7	0,7
Galium aparine L	0,1	0,1
Tripleurospermum inodorum L	16,5	1,6
Viola arvensis Murr.	0,3	0,3
Rhizomatous species	5	5
Elytrigia repens L	5	5
Roots sprout species averaged	2	0,2
Convolvulus arvensis L	4	2,0
Sonchus arvensis L	6	6
Rumex acetosella L	5	2,0
Rods root species averaged	5	2,0
Barbarea vulgaris R.Br.	5	0,2
Biennial species averaged	2	0,2
Melilotus album L	2	0,2
Daucus carota L	1	0,1
Echium vulgare L	5	0,5
Carduus nutans L	1	0,1
Weeds parasites	107	107
Orobanche cumana Wallr	100	100
Cuscuta campestris Yunck	114	114

This information demonstrates the highest seed productivity explerent weeds belonging to spring weed species and parasites. Biennial and perennial violent weeds by this characteristic are much smaller. Seed productivity also obvious experiencing significant effect of phytoenvironment in agrophytocenoses of alternative technological groups of crops. Its value in crops row crops in 3-10 was more compared to not row crops with narrow method of sowing.

To calculate the for allowance reproductive plants weeds in crops also need to know the change of the potential weediness arable land for the cultivation of particular crop. Quotient of the value of these changes on the value of seed productivity weed species indicate on the admission of their amount in reproductive condition.

Results of monitoring of potential arable weediness in the rotation are given in Table 2 show that during the year depending on cultivated crops the value of losses of weed seeds from soil 0-30 cm varies from 23% to 91% for the average module - 55%. Analysis of the structure of these costs indicates that they are overwhelming, 60% conditionality demise of weed seeds during the winter and 24% - the demise of seedlings. Noteworthy significant dependence expenditure balance of weed seeds in the soil not only on crops but also from their predecessors. For example, in the fields of winter wheat, the value depending on of its predecessors, varies from 23% for placement on corn silage and 72% - after peas.

Presented here (Table 1) the value of seed productivity per plant weed species (Sprod. thousand pcs.), The cost of seeds within one year from 0-30 cm soil layer (Table 2) L, and certain parts of the potential weediness arable physically normal seeds in this soil layer in spring, Pw million pcs./ha are arguments for constructing a model calculation of allowable amount of

reproductive plants sown weeds in specific crops (Aa pcs./m^2), for which there is an increase in potential weed-infested fields occupied by it :

Aa = L*Pw/Sprod*10,

where 10 - to express the amount ratio of plant weed in pcs/m^2

Table 2

The value of the annual balance of weed seeds in the soil layer of 0-30 cm depending on the crops in field rotation (average for 2002-2007)

Crops in rotation	Primary amount of spring million pcs/ha	Losses of seeds during the year		Structure of losses,%			
		million pcs/ha	%	Witherin g away of seeds during the summer	Withering away of seeds during the winter	Withe ring away of of seedli ngs	Stairs
Alfalfa	105	33	31	5	32	42	21
Winter wheat	100	38	38	0	76	15	9
Sugar beet	96	41	43	20	40	30	10
Maize silage	114	104	91	11	76	9	4
Winter wheat	187	43	23	2	72	19	7
Maize	148	55	37	2	83	13	2
Pea	202	152	75	0	37	55	8
Winter wheat	122	88	72	6	79	12	3
Sugar beet	152	98	64	10	67	21	2
Barley	122	97	79	32	45	20	3
On average rotation	135	75	55	9	60	24	7

For example, we calculate the amount of reproductive admission weeds in crops of winter wheat after peas quantitatively weediness of *Descurainia Sophia L.* - 10 pcs./m^2, *Apera spica venti L.*- 15 pcs./m^2 and *Centaurea cyanus L.*- 5 pcs./m^2 for potential weediness soil 0-30 cm these types - 50, 40 and 10 mln. pcs./ha, respectively. Normative for annual losses of weed seeds L = 0.7 units (Table 2). Weeds in agrophitocenosis of winter wheat in this example is composed of parts with 0.33 *Descurainia Sophia L.*, 0.5 parts - *Apera spica venti L.* and 0.17 parts - *Centaurea cyanus L.* Using the foregoing model determines that the admission of reproductive plants of *Descurainia Sophia L.* is 7 pcs./m^2 (0.7*50/0.5*10) *Apera spica venti L.* - 14 pcs./m^2 (0.7*40/0.2*10) and *Centaurea cyanus L.* - 1 pcs./m^2 (0.7 *10/0.6*10). Average allowance species in this example is 10 pcs./m^2 (7*0,33+14*0,5+1*0,17) with specified species types in particular weedy grouping.

For practical control weediness crops important is not only the calculation allowance amount of reproductive plants weeds but also the possibility of prediction. As a result of long-term monitoring (2007-2013) actual weediness crops in a stationary experiment with variants and farming systems of soil tillage in crop rotation zonal Right-Bank Forest-Steppe of Ukraine defines prediction coefficients terminal amount of reproductive plants weeds (Table 3).

The paper makes an illustration of the methodology for determining this ratio limit example of a culture of winter wheat . The results of long-term observations in a stationary experiment that became arguments for the calculation of the prognosis abundance of reproductive plants weeds while building its yield point to the dependence of the value of technology growing culture. In particular , the lowest coefficient appeared in the version used in the crop rotation system periodically tillage soil tillage system (Table 3). To prognosis the amount of reproductive plants weeds at the time of harvesting of crops (A) must be a amount of all weed stairs to the recovery of winter wheat spring vegetation (M) multiplied by Cp prognosis:

A = M*Cp, pcs/m^2

Table 3

Determination of the prognosis coefficient of amount of reproductive weeds at the winter wheat harvesting after pea relative to the stairs amount of weeds at the time of renewal of spring vegetation in a stationary experiment (average for 2007-2013)

Variants of the experiment		Amount of weeds pcs./m^2		Prognosis coefficient, Cp=A/M
Farming systems	Soil tillage systems	At the time of vegetation, M	Reproductive at the time of harvesting, R	
Industrial (control), organic fertilizer 12 t/ha NPK fertilizer 300 kg/ha, pesticides	Differentiated tillage (control)	83	27	0,32
	Subsurface tillage	99	41	0,41
	Periodically tillage	75	16	0,21
	Surface tillage	126	37	0,29
Environmental, 24t/ha organic fertilizers, mineral NPK 150 kg/ha, pesticides, biological plant protection	Differentiated tillage (control)	94	37	0,39
	Subsurface tillage	118	55	0,47
	Periodically tillage	88	27	0,31
	Surface tillage	144	49	0,34
Biological, organic fertilizers, biological plant protection	Differentiated tillage (control)	133	42	0,31
	Subsurface tillage	198	60	0,3
	Periodically tillage	128	32	0,25
	Surface tillage	243	76	0,31
On average, farming systems	Industrial (control)	96	30	0,31
	Environmental	111	42	0,37
	Biological	175	52	0,3
On average, soil tillage systems	Differentiated tillage (control)	137	35	0,25
	Subsurface tillage	138	52	0,38
	Periodically tillage	97	25	0,26
	Surface tillage	171	54	0,31

Note: 1. Rotation scheme: 1) alfalfa, 2) winter wheat, 3) sugar beet, 4) maize silage, 5) winter wheat, 6) maize, 7) peas, 8) winter wheat, 9) sugar beets, 10) barley

2. Differentiated tillage: using surface tillage once during rotation under barley, twice ridge tillage under winter wheat after silage corn and peas and six other tillage.

Conclusions. Described the methodology of determination for allowance of amount of reproductive weeds in agricultural crops and prognosis of their expected amount of criteria eco-economic threshold of weediness is designed to be methodical maintenance of economic, environmental and herbology effective control of weeds in modern agriculture.

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Анотація

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Методика визначення показників допуску рівня забур'яненості посівів сільськогосподарських культур для ефективного її контролю

Зроблений аналіз методики визначення показників господарського та еколого-економічного порогів забур'яненості посівів сільськогосподарських культур. Запропонована математична модель функції для розрахунку величини допуску рясності репродуктивних рослин бур'янів і прогнозу її очікуваної величини у якості методичного забезпечення контролю забур'яненості посівів.

Ключові слова: *рясність, допуск, репродуктивні бур'яни, прогноз, забур'яненість, контроль*

Аннотация

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Методика определения показателей допуска уровня засоренности посевов сельскохозяйственных культур для эффективного её контроля

Проведен анализ методики определения показателей хозяйственного и эколого-экономического порогов засоренности посевов сельскохозяйственных культур. Предложена математическая модель функции для расчета величины допуска обилия репродуктивных сорных растений и прогноза её ожидаемой величины в качестве методического обеспечения контроля засоренности посевов.

Ключевые слова: *обилие, репродуктивные сорняки, допуск, прогноз, контроль, засоренность*