harvesting terms from the intensive orchard. Compared with the fruit from trees on M.9 rootstock, the content of organic acids in apples of mass gathering from trees on the rootstock MM.106 was lower by 0.16 % (from a late collection by 0.18 %). At the end of a seven-month storage a post-harvest treatment with 1-MCP provides 2.1–2.2 higher level of organic acids in the fruits of mass harvesting from orchards of both types, 1.2 higher level in the fruits of late harvesting from intensive orchard and 2.6 higher level from a traditional one.

***Key words**: Reinette Simirenko, SmartFresh, 1-Methylcyclopropene, rootstock, harvest date, storage, soluble solids, titrable acidity.*

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EFFECTIVENESS OF APPLICATION OF BUCKWHEAT CROP DESICCATION UNDER THE CONDITIONS OF THE WESTERN FOREST-STEPPE

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Наведено результати багаторічних досліджень з вивчення впливу десикації на врожайність посівів гречки сортів Вікторія, Антарія, Малинка і Крупнозелена в умовах Лісостепу західного. Встановлено, що найефективнішою дозою десиканту Ураган Форте є внесення 3,5 л/га препарату за однофазного збору на 85 добу після появи сходів. Цей агрозахід забезпечить збір врожаю зерна гречки на рівні 1,41–1,67 т/га, й істотно мінімалізує її втрати на рівні 0,06–0,15 т/га.

***Ключові слова:** гречка, сорт, десикація, збір урожаю, врожайність.*

Introduction. The purpose of the strategy of crop production development is to ensure the stable growth of production for needs of the domestic and foreign markets and increase the efficiency of the industry. At the same time, one of the strategic goals of crop production development is the increase in volumes of gross production of crops and grain in accordance with 106.1 billion UAH and 80 million tons in 2020 [1]. Analysis of the development of cereal production indicates its importance for the formation of a balanced food market in Ukraine. This is due to existing national traditions in the food culture, both with high consumer and dietary properties of cereal products. Therefore, the improvement of the technology of growing such crops like buckwheat, millet, rice and peas is important and ***relevant*** for the development of agriculture in Ukraine.

Actual scientific researches and issue analysis. Desiccation use reduces the moisture content of grain and seeds, facilitates harvesting and reduces weediness, losses due to grain fall and costs to bring it to standard humidity [2, 3].

Based on results of the comparative analysis of data of the primary

toxicological assessment, results of subchronic and chronic experiments on several species of animals (rats, mice, rabbits and dogs) and peculiarities of biological action and long-term effects of active substances and preparations, it is found that Hurricane Forte 500 SL and Roundup preparations are moderately toxic according to the parameters of acute oral, dermal and inhalation toxicity (III Hazard Class) [4].

A number of nonselective herbicides of the systemic action are widely used for the desiccation of crops in the use of which peculiarities of their effects on a plant must be taken into account. So, Reglon and Basta quickly dry up the overland part of plants which means that damaged weeds can later grow and increase the vegetative mass. Roundup and Hurricane Forte operate more slowly but they provide destroying not only of the herb, but also of the root system, that is, their final effectiveness as desiccants is much higher. The effect of these preparations is that they cause cell death which in the future causes plants to dry up naturally. This is especially true for generative organs, which, as a rule, is the purpose of cultivating crops. The basic principle of the action of desiccants is that the plant cell dies due to the breakdown of the cell membrane and dehydration. True desiccants artificially affect the reduction of moisture content both in treated plants as a whole, and in their generative organs.

Such preparations are effectively used in a number of late-maturing crops which allows accelerated maturation and harvest without losses. In recent years, under the conditions of the Western Forest-Steppe, buckwheat crops are widely grown in postcut and stubble way [5, 6]. The harvest of such crops is in the middle of October when under the temperature regime this crop is not able to dry up sufficiently in the rolls, delaying the harvest period and increasing its loss. However, in references under the excellent soil-climatic conditions, existing recommendations sometimes contain controversial data or are schematic in nature.

Therefore, ***the purpose of our research*** was to study the effectiveness of desiccation use in the technology of buckwheat cultivation under the regional conditions of the Western Forest-Steppe.

Research methods. The research was conducted in 2013–2016 under the conditions of the experimental field of Podillia State Agrarian Technical University located in the southern part of Khmelnitsky region. It belongs to the southern thermal agro-climatic region by heat supply and degree of humidity during the growing season.

The schematic course of the experiment includes: A – a buckwheat variety (Victoria, Antaria, Malynka and Krupnozelena); B – dose of Hurricane Forte desiccant (2,5; 3,0; 3,5; 4,0 and 4,5 l/ha, without desiccants (*check variant*) – plants are collected by separate method after air-thermal drying in field conditions); C – harvesting periods (75, 80, 85 and 90 (*check variant*) days of vegetation).

Hurricane Forte is a non-selective herbicide of the systemic action; the active ingredient content is 500 g/l of potassium salt of glyphosate, water soluble concentrate, toxicity class – WHO III (low toxicity) and producer company is Syngenta (Switzerland).

The registration plot is 50 m^2, a number of repetitions are 4 and the predecessor is winter wheat. The method of sowing is wide-ranging with a width of rows of 45 cm and a seeding rate of 1.8 million seeds/ha. Records, analyzes and observations are conducted according to generally accepted methods [8, 9].

The soil of the experimental plot is extracted low-humus chernozem on carbonate forest loams. The solid phase density is 2,57–2,58 g/cm^3, the total porosity is 51,6–54,7 % and the moisture content of stable wilting is 9,18–9,50 %. The humus content (according to Tiurin) in the soil layer of 0–30 cm is 3,8–4,4 %, the content of easily hydrolyzed nitrogen (according to Cornfield) is 92–126 mg/100 g, mobile phosphorus and exchangeable potassium (according to Chirikov) respectively, 120 and 130 mg/100 g of soil, absorption capacity and amount of absorbed alkali – respectively, 33–36 and 30–33 mg/100 g of soil. Hydrolytic acidity is 2,3–2,8 mg/100 g of soil and the degree of saturation with alkali is 94,7–99,0 %.

Weather conditions of the growing season were different but, in general, they met the biological requirements of buckwheat plants. Separate periods of research years differed significantly in temperature conditions and conditions of humidification which gave an opportunity to better study the influence of investigated factors on the growth and development of plants and the formation of buckwheat harvest.

Research results. According to the results of many research years, it is found that on the fifth day after crop desiccation, the humidity of plants decreased almost twice. Thus, applying Hurricane Forte desiccant with the rate of 2.5 l/ha, the moisture content of stems in studied varieties was at the level of 51,2–52,2 % (table 1). With each subsequent increase in the desiccant dose by 0,5 l/ha, the humidity content of stems decreased accordingly by 1,1–5,7 %. At the same time, the most effective was the processing of buckwheat crops at the rate of 3.5 l/ha. The same pattern was on the tenth day after processing.

Humidity of plants in check variant areas mowed on the fifth day after air–dry drying in field conditions was 45,6–46,7 % and on the tenth day, respectively, 38,3–39,4 %.

Thus, the use of Hurricane Forte desiccant only in doses of at least 3,5–4,5 l/ha corresponded to requirements of direct harvesting standards.

The action of Hurricane Forte desiccant on the foliar surface of buckwheat plants showed defoliation and desiccation. At the same time, the desiccation prevailed. Part of lower leaves, due to the formation of a separate layer in the stalks, fell. The bulk of leaves dried up and remained until the harvest time.

Humidity of leaves on the tenth day after desiccant processing was in the range from 18,0 to 18,4 % (dose 2,5 l/ha) and from 14,8 to 16,2 % (dose 3,5–4,5 l/ha), which corresponded to requirements of direct harvesting standards.

Humidity of fruits on a buckwheat plant is determined by the ratio of their groups of different maturity. The least moist are ripe turned brown fruits and more humid are fruits of a different state of milk–wax maturation. At the time of harvest, the bulk of fruits ripen which is accompanied by a decrease in their humidity.

1. Dynamics of humidity of buckwheat plants depending on varietal characteristics and desiccant dose, 2013–2016

Variety / Rate, l/ha	Victoria		Antaria		Malynka		Krupnozelena	
	Humidity after processing, *per day*							
	5	10	5	10	5	10	5	10
Stem humidity, %								
Without desiccant (*check variant*)	45,6	38,7	45,8	38,5	45,6	38,3	46,7	39,4
2,5	51,3	41,2	51,2	40,7	51,1	40,8	52,2	41,2
3,0	46,0	39,1	46,3	38,8	46,2	38,3	46,9	39,6
3,5	45,3	38,2	45,1	35,9	45,0	36,8	46,0	38,4
4,0	44,3	36,5	44,9	35,2	44,7	36,3	45,3	38,2
4,5	44,0	36,1	44,2	34,9	44,5	36,0	44,9	37,8
Leaf humidity, %								
Without desiccant (*check variant*)	35,2	16,3	36,7	16,7	36,4	16,3	36,3	16,9
2,5	37,2	18,3	38,4	18,4	38,6	18,0	37,9	18,1
3,0	36,0	16,7	37,2	17,0	36,9	16,6	36,4	17,4
3,5	35,4	15,5	36,0	16,2	36,1	15,9	35,9	15,7
4,0	34,3	14,6	35,2	15,0	35,2	14,8	34,0	15,6
4,5	34,0	14,5	34,9	14,9	34,8	14,7	33,8	15,2
Fruits humidity, %								
Without desiccant (*check variant*)	37,9	16,2	37,4	16,0	36,9	16,2	38,1	16,9
2,5	39,6	17,2	40,3	17,6	40,3	16,7	40,4	17,8
3,0	38,2	16,8	37,8	16,3	37,2	16,4	38,3	17,0
3,5	37,3	15,4	37,0	15,6	36,7	15,2	37,4	16,4
4,0	37,1	15,2	36,9	15,3	36,0	15,0	37,2	15,5
4,5	36,9	15,0	36,7	15,1	35,8	14,8	37,0	15,2
$\bar{x}$	*39,71*	*23,29*	*40,05*	*23,06*	*39,63*	*23,04*	*40,28*	*23,86*
S	*5,01*	*10,88*	*4,90*	*10,25*	*4,96*	*10,66*	*5,40*	*11,01*
$S_{\bar{x}}$	*1,18*	*2,56*	*1,15*	*2,42*	*1,17*	*2,51*	*1,27*	*2,60*
V, %	*12,62*	*46,72*	*12,23*	*44,45*	*12,51*	*46,26*	*13,41*	*46,16*

The study of harvest data (Table 2) made it possible to establish that the minimum dose of desiccant proved to be ineffective for all varieties and terms of harvesting – the increase of this indicator compared to the check variant over all

years of research was not significant and did not exceed 0.01–0.03 t/ha (NIP_{05} = 0.06 t/ha). The increase in the dose of the preparation up to 3.0 l/ha somewhat improved the conditions for direct harvesting but the increase in grain yield was not significant and did not exceed 0.02–0.04 t/ha. In this respect, the most effective was a dose of at least 3.5 l/ha.

2. Yield dependence (t/ha) of buckwheat grain on the use of different doses of Hurricane Forte desiccant, 2013–2016

Variety (*Factor A*)	Timing of harvest (*Factor C*), *days*	Dose for applying desiccant (*Factor B)*, *l/ha*					
		Without desiccant (*check variant*)	2,5	3,0	3,5	4,0	4,5
Victoria	75	1,13	1,15	1,17	1,22	1,22	1,20
	80	1,24	1,26	1,27	1,30	1,30	1,28
	85	1,33	1,35	1.35	1,39	1,39	1,38
	90 (*check variant*)	1,26	1,27	1,28	1,32	1,31	1,31
Antaria	75	1,29	1,32	1,33	1,39	1,39	1,38
	80	1,37	1,39	1,41	1,47	1,46	1,46
	85	1,50	1,53	1,54	1,65	1,65	1,64
	90 (*check variant*)	1,43	1,47	1,48	1,53	1,53	1,52
Malynka	75	1,30	1,32	1,34	1,41	1,40	1,40
	80	1,39	1,42	1,43	1,51	1,50	1,50
	85	1,48	1,51	1,53	1,62	1,62	1,61
	90 (*check variant*)	1,40	1,42	1,45	1,52	1,52	1,51
Krupnozelena	75	1,28	1,30	1,34	1,39	1,38	1,38
	80	1,38	1,40	1,44	1,51	1,51	1,50
	85	1,48	1,50	1,53	1,58	1,58	1,57
	90 (*check variant*)	1,50	1,52	1,54	1,60	1,59	1,59
Medium		*1,36*	*1,40*	*1,43*	*1,46*	*1,46*	*1,46*
$LSD_{05(A)} = 0,07$; $LSD_{05(B)} = 0,06$; $LSD_{05(C)} = 0,07$; $LSD_{05(AB)} = 0,11$; $LSD_{05(AC)} = 0,12$; $LSD_{05(BC)} = 0,11$; $LSD_{05(ABC)} = 0,21$							

On average, over the years of research, in variants using this dose of the preparation, plants of all studied buckwheat varieties were the most losing moisture, best suited for single-phase harvesting and had the smallest losses. Thus, the grain yield within the studied variants of vegetation duration was at the level of

1,17–1,35 t/ha in Victoria variety, 1,33–1,54 t/ha in Antaria variety, 1,41–1,62 t/ha in Malynka variety and 1,39–1,60 t/ha in Krupnozelena variety. This yield provided significant increases in this indicator compared to the check variant, respectively, at the level of 0,06–0,09 t/ha (Victoria), 0,10–0,15 (Antaria), 0,10–0,11 (Malynka) and 0,10–0,13 t/ha (Krupnozelena) at LSD_{05} (B) = 0,06 t/ha.

As the grain yield of all varieties remained unaltered (within the limits of the error), further increase in the dose of Hurricane Forte to 4,0–4,5 l/ha was not appropriate.

Depending on the duration of the growing season, it was found that for Victoria, Antaria and Malynka varieties the most optimal is single-phase harvesting for 85 days from the beginning of sprouts after the previous desiccation of crops. The productivity was the highest and on average, over the years of research, respectively, amounted to 1,39, 1,65 and 1,62 t/ha. Subsequent delay with the use of this agricultural method to the duration of vegetation in 90 days caused significant losses of crop of these varieties at the level of 0,07–0,10 t/ha with LSD_{05} (C) = 0,07 t/ha. For the late-maturing Krupnozelena variety, the last of studied harvesting periods was also optimal (90 days). Thus, for the use of these harvesting periods in combination with desiccation, the highest yield was obtained at the level of 1,58–1,60 t/ha which is by 0,07–0,21 t/ha significantly more than other harvesting variants (Fig.).

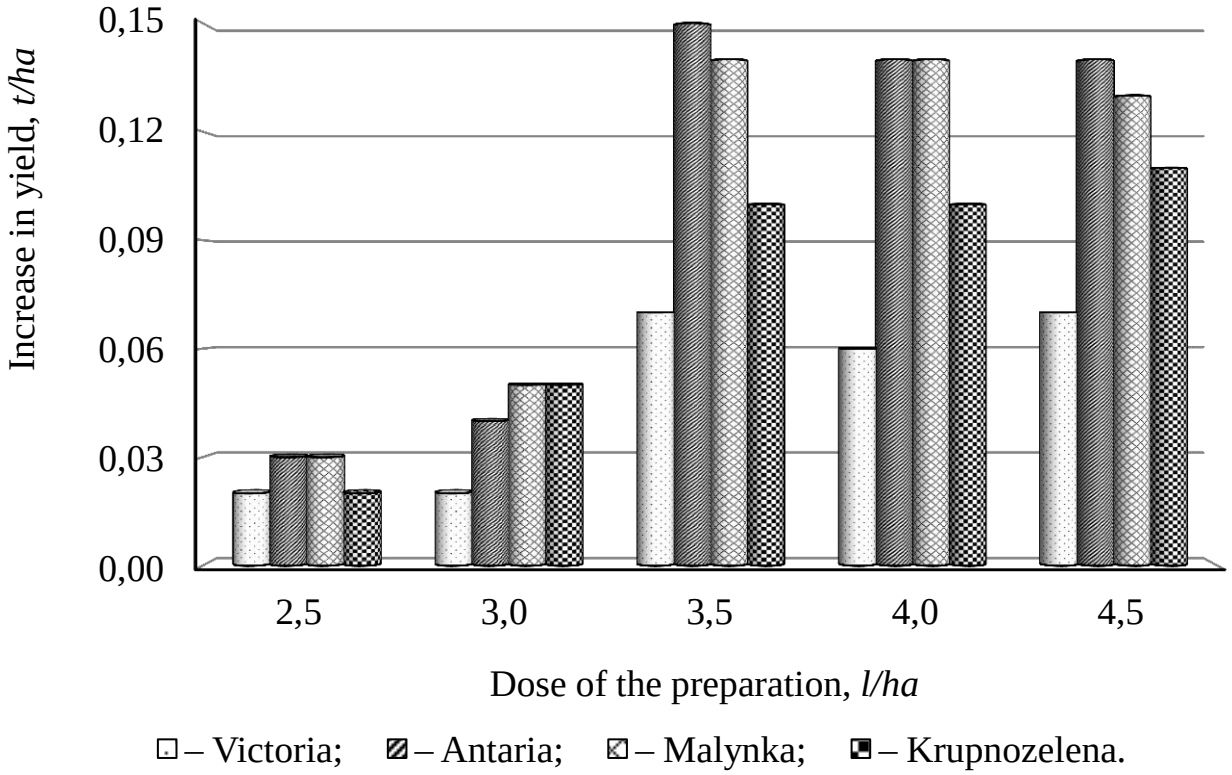

Fig. **Growth of yield (t/ha) of buckwheat varieties in the application of Hurricane Forte desiccant and 85-day harvesting, 2013–2016**

According to the results of the laboratory analysis of buckwheat grain harvested after processing with desiccants, residues of desiccants in each of the studied varieties were not detected.

Conclusion. 1. The use of desiccation in the technology of buckwheat cultivation makes it possible to harvest this crop in time and with the slightest losses.

2. The most effective dose of Hurricane Forte desiccant is application of 3,5 l/ha of the preparation for a single-phase 85–day harvesting after sprouts which provides the highest yield in Victoria variety (1,41 t/ha), Antaria variety (1,67 t/ha), Malynka variety (1,62 t/ha) and in Krupnozelena variety on the 90^{th} day (1,58 t/ha).

3. On average, during the years of research, the use of Hurricane Forte desiccant for different buckwheat varieties substantially minimized the loss of grain yield at the level of 0,15 t/ha in Antaria variety, 0,14 t/ha in Malynka variety and 0,10 t/ha in Krupnozelena variety (LSD_{05} = 0,06 t/ha).

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Аннотация

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Эффективность применения десикации в посевах гречихи в условиях Лесостепи западной

Сбор поукосных и пожнивных посевов приходится на середину октября, когда за температурным режимом гречиха не в состоянии достаточно высохнуть в валках, что задерживает сроки сбора и увеличивает потери урожая. Однако, в литературе по отличных почвенно-климатических условиях, существующие рекомендации иногда содержат противоречивые данные или носят схематичный характер. Поэтому, целью наших исследований было изучение эффективности использования десикации в технологии выращивания гречихи в региональных условиях Лесостепи западной. Методика исследований. Исследования проводились в течение 2013–2016 годов в условиях опытного поля Подольского государственного аграрно-технического университета, находящегося в южной части Хмельницкой области, которая по теплообеспечённости и степени увлажненности в течение вегетационного периода относится к южному тепловому агроклиматическому региону. Схема опыта предполагала следующую градацию факторов: А – сорт гречихи (Виктория, Антария, Малинка, Крупнозеленая); В – доза десиканта Ураган Форте (2,5; 3,0; 3,5; 4,0 и 4,5 л/га, без обработки десикантами (контроль) – растения собраны раздельным методом после воздушно-тепловой просушки в полевых условиях); С – срок сбора урожая (75, 80, 85 и 90 (контроль) суток вегетации посевов после появления всходов). Площадь учетной участка 50 м^2, повторений четыре, предшественник пшеница озимая. Способ сева широкорядный с шириной междурядий 45 см и нормой высева 1,8 млн шт/га. Учеты, анализы и наблюдения проводили по общепринятым методикам. По результатам многолетних исследований установлено, что в вариантах с использованием дозы 3,5 л/га растения всех исследуемых сортов гречихи наиболее интенсивно теряли влагу, были лучше пригодны к однофазному сбору урожая и имели минимальные его потери. Так, урожайность зерна в пределах исследуемых вариантов продолжительности вегетации у сорта Виктория была на уровне 1,17-1,35 т / га, Антария – 1,33–1,54, Малинка – 1,41–1,62 и Крупнозеленая – 1,39–1,60 т/га. В зависимости от продолжительности вегетации было установлено, что для сортов Виктория, Антария и Малинка оптимальным является однофазный сбор урожая на 85 сутки от начала появления всходов после предварительной десикации посевов – урожайность здесь была наивысшей и в среднем за годы исследований соответственно составила 1,39 т/га, 1,65 и 1,62 т/га. Для позднеспелых сортов Крупнозеленая,

оптимальным также был и последний из исследуемых сроков сбора – 90 суток. Так, за использование этих сроков сбора в сочетании с десикацией получено наивысшую урожайность на уровне 1,58–1,60 т/га. По результатам лабораторного анализа зерна гречихи, собранного после обработки десикантами, остатков десикантов в каждом из исследуемых сортов не обнаружено. Выводы. Эффективной дозой десиканта Ураган Форте является внесение 3,5 л/га препарата при однофазном сборе на 85 сутки после появления всходов, что обеспечивает наивысшую урожайность у сорта Виктория – 1,41 т/га, Антария – 1,67, Малинка – 1,62 т/га, и на 90 сутки у сорта Крупнозеленая – 1,58 т/га.

***Ключевые слова**: гречиха, сорт, десикация, срок уборки урожая, урожайность.*

Annotation

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Effectiveness of application of buckwheat crop desiccation under the conditions of the western Forest-Steppe

The harvest of buckwheat crops in postcut and stubble way is in the middle of October when under the temperature regime this crop is not able to dry up sufficiently in the rolls, delaying the harvest period and increasing its loss. However, in references under the excellent soil-climatic conditions, existing recommendations sometimes contain controversial data or are schematic in nature. Therefore, the purpose of our research was to study the effectiveness of desiccation use in the technology of buckwheat cultivation under the regional conditions of the Western Forest-Steppe. Research methods. The research was conducted in 2013–2016 under the conditions of the experimental field of Podillia State Agrarian Technical University located in the southern part of Khmelnitsky region. It belongs to the southern thermal agro-climatic region by heat supply and degree of humidity during the growing season. The schematic course of the experiment includes: A – a buckwheat variety (Victoria, Antaria, Malynka and Krupnozelena); B – dose of Hurricane Forte desiccant (2.5; 3.0; 3.5; 4.0 and 4.5 l/ha, without desiccants (check variant) – plants are collected by separate method after air-thermal drying in field conditions); C – harvesting periods (75, 80, 85 and 90 (check variant) days of vegetation). The registration plot is 50 m^2, a number of repetitions are 4 and the predecessor is winter wheat. The method of sowing is wide-ranging with a width of rows of 45 cm and a seeding rate of 1.8 million seeds/ha. Records, analyzes and observations are conducted according to generally accepted methods. According to the results of many research years, in variants using the dose of 3.5 l/ha of the preparation, plants of all studied buckwheat varieties were the most losing moisture, best suited for single-phase harvesting and had the smallest losses. Thus, the grain yield within the studied variants of vegetation duration was at the level of 1.17–1.35 t/ha in Victoria variety, 1.33–1.54 t/ha in Antaria variety, 1.41–1.62 t/ha in Malynka variety and 1.39–1.60 t/ha in Krupnozelena variety. Depending on the duration of the growing season, it was found that for Victoria, Antaria and Malynka varieties the most optimal is single-phase harvesting for 85 days from the beginning of sprouts after the previous desiccation of crops. The productivity was the highest and on average, over the years of research, respectively, amounted to 1.39, 1.65 and 1.62 t/ha. For the late-maturing Krupnozelena variety, the last of studied harvesting periods was also optimal (90 days). Thus, for the use of these harvesting periods in combination with desiccation, the highest yield was obtained at the level of 1.58–1.60 t/ha. According to the results of the laboratory analysis of buckwheat grain harvested after processing with desiccants, residues of desiccants in each of the studied varieties were not detected. Conclusions. The most effective dose of Hurricane Forte desiccant is application of 3.5 l/ha of the preparation for a single-phase 85–day harvesting after sprouts which provides the highest yield in Victoria variety(1.41 t/ha), Antaria variety (1.67 t/ha), Malynka variety (1.62 t/ha) and in Krupnozelena variety on the 90th day (1.58 t/ha).

***Key words:** buckwheat, variety, desiccation, harvesting period, yield.*

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ОЗНАКИ ЯКОСТІ ХЛІБА РІЗНОГО БОРОШНА СОРТІВ І ЛІНІЙ ПШЕНИЦЬ

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Наведено результати вивчення хлібопекарських властивостей зерна і кулінарне оцінювання хліба з борошна пшениць вищого сорту та обойного. Встановлено, що на величину глянцю поверхні хліба, аромат, смак, еластичність, консистенцію під час розжовування та загальну оцінку впливає вміст білка в зерні. Дещо менше на показники якості хліба впливає вміст клейковини. Крім цього на еластичність м'якуша хліба та консистенцію під час розжовування також впливає індекс деформації клейковини.

Ключові слова: *пшениця м'яка, пшениця щільноколоса, пшениця ефіопська, хліб, кулінарна оцінка, хлібопекарські властивості.*

Постановка проблеми. Найважливішим показником якості зерна є хлібопекарські властивості. Кулінарна оцінка хліба залежить від низки хлібопекарських показників, основними з яких є вміст білка, клейковини, її якість, розрідження тіста за показником фаринографа, питома робота деформації тіста за показником альвеографа [1]. На формування якості зерна пшениці впливають ґрунтово-кліматичні умови та елементи агротехнології, проте рівень їхньої детермінації залежить від генетичних особливостей сорту [2, 3]. Тому вивчення ознак якості хліба залежно від сорту та лінії є актуальним.

Аналіз останніх досліджень і публікацій. Хлібопекарські властивості мають полігенну природу. Так, гени, які визначають хлібопекарські властивості зерна пшениці, локалізовано в хромосомах геномів 1D, 2A, 2B, 2D, 3A, 3B, 3D, 4A, 4B, 4D, 5A, 5B, 5D. Дуже низьку якість хліба контролюють гени, які знаходяться в хромосомах 1D, 2A, 2B, 3D, 6B, 7D [4]. Синтез клейковиноутворювальних білків пшениці локалізовано в хромосомах 1A, 1B, 1D, 6A, 6B і 6D [5]. Найбільший вплив на об'єм хліба, його поверхню та пористість впливає комплекс генів, локалізованих у хромосомах геному B [6].

Зазвичай вміст білка та клейковини має високий кореляційний зв'язок з якістю хліба [7, 8]. Відомо, що мінімальний вміст білка за якого борошно здатне формувати тісто, становить 7,5 % [9]. Максимальний вміст білка для сортів пшениці м'якої ярого типу становить 17 %, а озимого – 19 % [10]. Проте з борошна низки сортів пшениці за вмісту клейковини понад 40 % не завжди можна отримати хліб високої якості [4]. Відомі випадки високої сили борошна (381 о. а.) за вмісту клейковини 23,0 %. Об'єм хліба з борошна сорту Саратовська 29 за вмісту клейковини 16,9 і 25,0 % становив відповідно 514 і 524 $см^3$ [10]. Вважають, що підвищення вмісту білка понад 19 % селекційно-