According to the methodology and determined program, by spring sowing in 2014 was followed a three-factor experiment after precursor one-year cereals, namely maize on green fodder. Repeat of experiment – quadruple. All grass mixtures were fertilized in accordance with scheme of experiment by following types of fertilizers: nitric – in the form of ammonium nitrate (34% a. i.), potassium – potassium magnesia (26% a.i.), phosphorus – superphosphate (18.7% a.i.), as well as growth stimulator Fumar in the range 2l / ha on phase of grass tillering and alfalfa stooling.

Research was carried out in accordance with generally accepted methods for fodder production and meadow growing [6].

Main results of research. It is known that the density of any herbage, including alfalfa, is an important indicator, since shoots are an important organ on which the leaf surface is formed, which has a decisive role in yield formation [7].

Taking into account importance of this indicator, in conducted experiments was studied changes in the density of alfalfa and cereal herbage depending on species composition, seeding rates and fertilizing levels. Among the studied elements the most influential factors in terms of density were species composition and fertilizing. Significant changes in herbages density were observed in the first year of research. Due to these factors, during all years of research, the most intense tillering formation was observed in awnless brome, perennial ryegrass, as well in all grass mixtures with these species. Crops were characterized by intense growth and formed herbage with greater height, leaf width, intense sprout formation, which positively affected on its botanical composition, leaf surface formation and yield (Table 1).

Thus, alfalfa-cereal grass mixtures, which consisted of awnless brome, perennial ryegrass, provided a large number of shoots, their greater height and leaf surface, which ultimately contributed to the formation of higher yields. At the same time, the mentioned cultures were distinguished not only by intense sprout formation but also by high phytocoenic activity. Thus, in grass mixtures, they used resources of the environment more thoroughly than other types; therefore, during the years of research they formed quickly and became dominant in above-ground phytomass accumulation.

On the basis of research, it was found that largest density (Table 1) was formed by grass mixtures: alfalfa + awnless brome + perennial ryegrass with mineral fertilizers $N_{60}P_{60}K_{90}$ and growth stimulator Phumar application it was 1285 pieces / m^2. Applying of such important technology element as mineral fertilizers introduction, can to some extent control the process of forming optimum density of herbage, and significantly affect herbage productivity and quality of the feed.

Little bit lower density, was provided by grass mixtures, which consisted from alfalfa + meadow fescue + reed fescue, without fertilizer, it was 1077 pcs. / m^2.

It is common knowledge that yields of grasses consists from different types of shoots, their organs, and density of standing. In addition, plant density – an important factor that determines intensity and nature of relationship between plants.

Conclusions. Consequently, density of alfalfa-cereal mixtures is one of important indicators, which directly affects on yield of perennial grasses and most depends on species composition and level of mineral nutrition. The greatest number of shoots and density increasing were observed in grass mixtures: alfalfa + awnless brome + perennial ryegrass with mineral fertilizers $N_{60}P_{60}K_{90}$ and growth stimulator Phumar application it was 1285 pcs. / m^2.

References

1. Bezkrovny A.K., Bistritsky V.S., Tsyupa M.G. Crop rotations on drained lands // Crop rotation – the basis of intensive farming. K., 1986. P. 241–252.
2. Demidas G.I. Yamkova V. V. Change in the productivity of cereal-bean mixtures on the green mass, depending on the density of their crops // Feed and fodder production, 2011. V. 69. P. 152–156.
3. Efimov V.N., Tsarenko V. P., Yudishkin T.A. Nitrogen fertilizer balance under perennial grasses on peat lowland soils of the northwest of the Non-blacksoil zone RSFSR. 1989. P. 15–19.
4. Demidas G.I., Demtsyura Y.V. Formation of density of sown agrophytocenoses depending on the species composition of perennial grasses and their fertilizer level // Vestnik Uman National University. 2016. P. 56–58.
5. Petrichenko V.F. Actual problems of development of modern feed production in Ukraine // Bulletin of Agrarian Science. 2006. №. 12. P. 55–56.
6. Babich A.O. Methodology of experiments on fodder production // Vinnytsia, 1994. P. 96.
7. Kozyar O.M. Formation of a leafy machine by bean-cereal agrophytocenoses depending on their composition and level of mineral fertilizing in conditions of right-bank Forest-Steppe of Ukraine // Scientific Bulletin of the National Agrarian University. 2006. Vol. 102. P. 96–101.
8. Demidas G.I., Kvitko G.P., Polishchuk I.S., et. all. Perennial grasses as a factor in the sustainable development of agriculture in Ukraine // National Academy of Agrarian Sciences of Ukraine, Institute of Agriculture of the National Academy of Agrarian Sciences, National Science Center. 2013. P. 31–34.

Л. М. Єрмакова
канд. с.-г. наук, доцент кафедри рослинництва,
Національний університет біоресурсів
і природокористування України

УДК 633.85:631.5

Т. І. Пророченко
аспірант кафедри рослинництва,
Національний університет біоресурсів
і природокористування України

СТРУКТУРА ВРОЖАЮ РІПАКУ ЯРОГО ЗАЛЕЖНО ВІД ШИРИНИ МІЖРЯДЬ ТА НОРМИ ВИСІВУ НАСІННЯ В УМОВАХ ПРАВОБЕРЕЖНОГО ЛІСОСТЕПУ УКРАЇНИ

Анотація. *Наведено результати досліджень, спрямованих на вивчення та визначення комплексного впливу норм висіву та ширини міжрядь на формування продуктивності рослин ріпаку ярого сорту Сіріус та гібриду Озорно в умовах Правобережного Лісостепу України, а також визначення зв'язків між досліджуваними показниками зі структурними елементами врожаю. Дослідження проводились протягом 2015-2017 рр. в умовах стаціонарної польової сівозміни кафедри рослинництва у ВП НУБіП України «Агрономічна дослідна станція». Ґрунти — чорноземи типові (глибокі) малогумусні, грубопилувато-легкосуглинкового механічного складу. Дослідження проводилися з сортом Сіріус та*

гібридом Озорно. Сівбу проводили сівалками Клен та СЗ-3,6, формуючи різну ширину міжрядь: 12,5, 15,0, 25,0 та 30,0 см з нормою висіву сортів та гібридів 0,8, 1,0, 1,2 та 1,4 млн. схожих насінин на гектар. У результаті проведених нами досліджень встановлено, що в умовах Правобережного Лісостепу України оптимальною шириною міжрядь для сорту Сіріус є 15,0 см з нормою висіву 1,2 млн.сх.нас./га, для гібриду Озорно відповідно 12,5 см та 0,8 млн.сх.нас./га.
Ключові слова: *ріпак ярий, ширина міжрядь, норма висіву, сорт, гібрид, структура врожаю, маса 1000 насінин.*

Л. М. Ермакова
канд. сельскохозяйственных наук, доцент кафедры растениеводства, Национальный университет биоресурсов и природопользования Украины
Т. И. Пророченко
аспирант кафедры растениеводства, Национальный университетбиоресурсов и природопользования Украины

СТРУКТУРА УРОЖАЯ РАПСА ЯРОВОГО В ЗАВИСИМОСТИ ОТ ШИРИНЫ МЕЖДУРЯДИЙ И НОРМЫ ВЫСЕВА СЕМЯН В УСЛОВИЯХ ПРАВОБЕРЕЖНОЙ ЛЕСОСТЕПИ УКРАИНЫ

Аннотация. *Приведены результаты исследований, направленных на изучение и определение комплексного воздействия норм высева и ширины междурядий на формирование продуктивности растений рапса ярового сорта Сириус и гибрида Озорно в условиях Правобережной Лесостепи Украины, а также определения связей между исследуемыми показателями со структурными элементами урожая. Исследования проводились в течение 2015-2017 гг. В условиях стационарного полевого севооборота кафедры растениеводства в ОП НУБиП Украины «Агрономическая опытная станция». Почва – черноземы типичные (глубокие) малогумусный, грубопилувато-легкосуглинковых механического состава. Исследования проводились с сортом Сириус и гибридом Озорно. Севбу проводили сеялками Клен и СЗ-3,6, формируя различную ширину междурядий: 12,5, 15,0, 25,0 и 30,0 см с нормой высева сортов и гибридов 0,8, 1,0, 1,2 и 1,4 млн. всхожих семян на гектар. В результате проведенных нами исследований установлено, что в условиях Правобережной Лесостепи Украины оптимальной шириной междурядий для сорта Сириус является 15,0 см с нормой высева 1,2 млн. всх. сем./га, для гибрида Озорно соответственно 12,5 см и 0, 8 млн.всх.сем./ га.*
Ключевые слова: *рапс яровой, ширина междурядий, норма высева, сорт, гибрид, структура урожая, масса 1000 семян.*

L. M. Ermakova
PhD of Agriculture Sciences, Associate professor of the Department of Planting Growing, National University of Life and Environmental Sciences of Ukraine
T. I. Prorochenko
Postgraduate Student of the Department of Planting Growing, National University of Life and Environmental Sciences of Ukraine

YIELD STRUCTURE OF SPRING RAPE DEPENDING ON WIDTH BETWEEN ROWS AND SEEDING RATES IN CONDITIONS RIGHT-BANK FOREST-STEPPE OF UKRAINE

Abstract. *Results of researches aimed at studying and determining the complex influence of seeding rates and row spacing on productivity formation of spring rape variety Sirius and hybrid Ozorno in conditions Right Bank Forest-Steppe of Ukraine are presented, as well was determinate relationships between investigated parameters and structural elements of the culture. Research was conducted during 2015-2017 under conditions of stationary field crop rotation of Plant Growing Department PE NULES of Ukraine "Agronomic Experimental Station". Soils – is typical (deep) low-humus blacksoil, rough-pew-loamy by mechanical composition. Research was conducted with variety Sirius and hybrid Ozorno. Sowing was carried out with seeder Klen SZ-3.6, with forming different widths of rows: 12.5, 15.0, 25.0 and 30.0 cm with seeding rates of varieties and hybrids 0.8, 1.0, 1.2 and 1.4 million similar seed per hectare. As a result of our researches, it has been established that in conditions Right Bank Forest-Steppe of Ukraine the optimum width of row spacing for variety Sirius is 15.0 cm with seeding rate 1.2 million seeds/ha, for hybrid Ozorno respectively 12.5 cm and 0,8 million s/ha.*
Key words: *spring rape, row spacing, sowing norm, variety, hybrid, harvest structure, 1000 seed mass.*

Problems formulation. Rape is one of the most active and dynamic export-oriented transfer facilities in the domestic plant growing industry. In recent years, accumulated experience has been summarized and logistics schemes have been developed. Meanwhile, agricultural producers, academics, educators and managers relying on certain practical technologies missed a rather important approach. First of all, rape is a real opportunity to expand raw material base of the oily-fat complex with fairly real prospects. A feature of the rape is that, during its cultivation, farmer has the opportunity to receive working capital at earlier times and to balance precursors in the system of crop rotation and soil fertility [5, 7].

As well as all plants of the cruciferae family, there is a significant influence on spring rape productivity formation, along with dates of sowing, the width between rows and sowing rates. Contradictory data about sowing rates of winter and spring rape lead to overexertion of seeds or low yields of crop, and, ultimately, to reducing efficiency of rape production as an industry in general. Along with it is paying a lot of attention to rape, one of the most widely spread oilseeds in the world [1, 3, 6].

In terms of cultivation technology, this culture in conditions Right Bank Forest-Steppe is not sufficiently studied. Rape growing technologies development for various regions of Ukraine, including for the Kyiv region, has not been fully developed so far, to ensure their effective implementation in production.

Analysis of recent research and publications. Scientific institutions of Ukraine and the world are constantly creating new high-yielding and low-glucosinolate varieties and hybrids of rape, which deserve high attention, but in the conditions Right Bank Forest-Steppe still have not been fully explored.

In spring rape growing technology, as well as other crops, sowing is an important technological process, the important factors of which are width between rows and sowing rate. By sowing is determined: plant nutrition area, even sprouts, length of plants vegetation period, etc. Consequently, growth, development and productivity of plants in many respects depend on sowing technology in general and the ways it is carried out, in particular.

A number of scientists involved in the study of the rape growing technology elements, note the crucial importance of solving the problem creating an optimal supply area by selecting a method of sowing and sowing rates.

Theoretical substantiation of different areas of plants nutrition according to the methods of sowing are set out in works A. V. Yunik, Y.V. Khmel'yanshchin, P.S. Vishnevsky, F.M. Kuperman, M.S. Savitsky, N.N. Ul'rich, I.I. Sinyagin and

others.

Regarding to the choice of optimum sowing rate and sowing method, there is no consensus. O. I. Polyakov in his studies found that the highest yield of spring rape was obtained with usual row method of sowing with sowing rate 2.0 million seeds/ha, and for wide-row sowing method – sowing rate 1.5 million s/ha [4]. Optimal sowing rate in experiments V.V. Satubaldin was 3–4 million. s/ha by usual row method. P.S. Vishnevsky, in the course of his research, found that spring rape sowing should be carried out with width between rows 15.0 cm and with sowing rate1.5 million seeds per hectare in early terms [2].

Consequently, we can conclude that for each variety (hybrid) and under different growing conditions, the optimal sowing rate will be own. Even in one region, research results are controversial sometimes. Therefore, a differentiated approach is needed for each region and variety (hybrid), which will allow optimal row spacing and sowing rates to be achieved in order to obtain the highest unit-to-area productivity.

The purpose of research was to determine complex effect of sowing rates and row spacing on spring rape productivity formation variety Sirius and hybrid Ozorno in conditions Right Bank Forest-Steppe of Ukraine, as well links determination between the investigated parameters and structural elements of the culture.

Methods of research. In order to solve the set of tasks during 2015–2017, we conducted field research at the field of stationary field crop rotation Plant Growing Department at the PE NULES of Ukraine "Agronomic Research Station" (Vasylkiv district, Kyiv region, Pshenichne village).

Soils – typical low-humus black soils, rough-pew-loamy by mechanical composition. Plowing layer has a grainy-dust-free, sublime-nut-grainy structure. By mechanical composition, soil has 37% of physical clay and 63% of sand. Humus content in the arable layer is 4.2–4.6%, absorption capacity is 31–32 mg-ek per 100 g soil, degree of saturation with the bases is about 90%. In a soil layer 0-20 cm contains 0.2–0.31% of total nitrogen, 0,15–0,25% phosphorus and 2.3–2.5% of potassium. The content of mobile phosphorus is 4.0–5.5 mg per 100 g soil (high), exchangeable potassium – 15.0–16.5 mg per 100 g soil (above average), easyhydrolyzed nitrogen – about 14–16 mg/100 g (higher the average). Reaction of soil solution is close to the neutral pH of salt extract 6.7–7.0.

Research was conducted with variety Sirius and hybrid Ozorno. Sowing was carried out by seeder Klen SZ-3.6, with forming different widths between rows: 12.5, 15.0, 25.0 and 30.0 cm and with sowing rates of varieties and hybrids 0.8, 1.0, 1.2 and 1.4 million similar seed per hectare.

The area of registration plot is 25 m². Repeating of experiment 4-ruple.

Main results of the study. An important indicator of spring rape yield formation is its structure, which is determined by the following elements: plant density per area unit, number of branches and pods per plant, average number of seeds per pod and weigh 1000 seeds. The maximum seed yield is formed at their optimal ratio, but with insufficient development of one structural element, yield can be offset by other indicators.

Yield structure includes several indicators, which depend on both soil and climatic conditions, varietal characteristics, and a number of parameters determined by the technology of this crop growing.

Indicators of yield structure are quite variable and depend on the specific conditions that form the quantitative expression each of them. In order to substantiate the yields that were obtained in conditions, created by the experimental variants, we analyzed the spring rape yield structure.

An analysis of obtained data, on average over the years of research, showed that yield structure indicators of the crop were highest in variety Sirius with sowing rate 1.2 million similar seed/ha. Thus, for widths of row spacings12.5 cm, the number of pods per plant was 56.0 pcs., what is on 11.4 pcs. more than with width of row spacings 30.0 cm. Sowing rate Increasing led to decrease in the number of seeds in the pod. In terms of sowing in rate 1.4 mln. s/ha with row spacing 12.5 and 15.0 cm, on average, the number of seeds per pod was reduced by 4.9 and 4.1, respectively (Table 1).

Таблиця 1

Yield indicators variety Sirius depending on cultivation technology elements (2015–2017)

Sowing rate, million similar seed/ha	Quantity			Weigh 1000 seeds, g
	pods per plant, pcs.	seeds per pod, pcs.	seeds per 1м²	
Row spacing 12,5 см				
0,8	52,1	22,8	59,4	4,10
1,0	54,1	23,0	65,9	4,08
1,2	56,0	24,9	78,1	4,05
1,4	53,0	21,0	64,6	3,89
Row spacing 15,0 см				
0,8	52,4	22,9	52,8	4,15
1,0	54,2	23	58,6	4,12
1,2	56,8	25,2	71,6	4,10
1,4	53,3	21,1	60,7	3,91
Row spacing 25,0 см				
0,8	49,2	19,9	41,1	3,98
1,0	51,1	19,3	43,4	3,92
1,2	53,2	20,8	49,8	3,88
1,4	50,0	18,8	44,2	3,75
Row spacing 30,0 см				
0,8	39,8	18,5	28,7	3,97
1,0	41,2	19,8	32,6	3,90
1,2	44,6	21,6	40,5	3,81
1,4	40,1	17,9	32,3	3,71

Reducing the number of seeds in a pod and existing pods per plant resulted in decrease in amount of seeds from 1 m^2 and, consequently, in crop yields as a whole. Sowing rate 1.2 million. s/ha of variety Sirius and width of row spacings 12.5 and 15.0 cm, the number of seeds with 1m2 was 78.1 and 71.6 ths. respectively. the smallest in variety It was with sowing rate 0.8 million s/ha and row spacing 30.0 cm and amounted 28.7 thousand pieces, due to lower quantity pods per plant, seeds in a pod and standing density of rape plants.

A similar pattern was observed with a weight 1000 seeds, where, with an increase in sowing rate to 1.4 million s/ha it decrease with widths between rows12.5 cm to 0.21 g, 15.0 cm – 0.24, 25.0 cm – 0.23, 30.0 cm – 0.26 g. The highest weight 1000 seeds were with 15.0 cm width between rows and rate 0.8 million similar seed per hectare.

Obtained results are analogous to the studies of scientists Vasilkin V.M. and Heidderbrech I.P., who also note that when seeding rates of rape seeds increase, a smaller number of pods per plant are produced and the weight 1000 seeds are reduced.

Analyzing yield structure indicators for hybrid Ozorno, average for the years of research, can be noted that there are the same patterns as in variety Sirius. However, the optimum seeding rate for hybrid was 0.8 million s/ha and row spacing 12.5 cm, in which hybrid plants formed the largest number of pods per plant, seed in a pod and seed from 1m^2. (Table 2).

Таблиця 2

Yield indicators variety Sirius depending on cultivation technology elements (2015–2017)

Sowing rate, million similar seed/ha	Quantity			Weigh 1000 seeds, g
	pods per plant, pcs.	seeds per pod, pcs.	seeds per 1м^2	
Row spacing 12,5 см				
0,8	57,7	25,8	77,4	4,27
1,0	56,1	24,9	74,0	4,25
1,2	54,7	24,6	72,7	4,00
1,4	54,2	24,1	70,8	3,80
Row spacing 15,0 см				
0,8	57,6	25,7	75,5	4,26
1,0	56,2	24,7	72,2	4,24
1,2	54,6	24,6	71,2	4,00
1,4	54,0	23,9	69,6	3,79
Row spacing 25,0 см				
0,8	49	21,0	40,1	4,13
1,0	53,7	21,8	51,9	4,10
1,2	52,8	21,6	48,0	3,95
1,4	50,1	20,8	46,9	3,71
Row spacing 30,0 см				
0,8	40,9	19,0	29,5	4,03
1,0	42,6	20,3	34,6	4,00
1,2	42,1	20,0	35,4	3,81
1,4	41,0	19,8	34,9	3,75

The weight 1000 seeds was higher than in Sirius variety. For the optimal width of row spacing and sowing rates, it exceeded the index variety on 0.12 g.

Conclusion. As a result of our researches, it was found that on typical low-humus black soils in conditions Right-Bank Forest-Steppe of Ukraine the best indicators of yield structure variety Sirius were with 15.0 cm row spacing and sowing rate 1.2 million similar seeds 1 hectare, in hybrid Ozorno – respectively 12.5 cm and 0.8 million similar seeds per 1 hectare.

References

1.Hansgeorg Schönberger. Rape cultivation // Manual for the care of crops and provision of yield AgroConcept GmbH. 2012. P. 9.

2. Vishnivsky P. S. Efficiency of rape and its dependence on cultivating technology // Materials of the second inter-university scientific-practical conference of post-graduate students "Modern agricultural science: directions of research, state and prospects" February 27–28, 2002, Vinnytsia, 2002. P. 65 – 66.

3. Kalenska S., Kalenskiy V., Kachura I., Kovalenko N. Plant resources of Ukraine in solving of food and energy security // Rolnictwo, gospodarka, obszary wielskie – 10 lat w Unii Europelskiel, Warshawa: Wydawnictwo SGGW, 2014. P.147 – 157

4. Polyakov O. I., Nikitenko O. V. Yield formation of spring rape, depending on agro methods of cultivation inconditions of the southern steppe of Ukraine [Text] // Scientific and technical bulletin of the Institute of Oilseeds of NAAS. 2012. № 17. P. 134–138.

5. Satubaldin K.K. Technology of rape and coleseed cultivation in conditions of Middle Urals [Text]: diss.... Dr. Agriculture. Sciences . Yekaterinburg, 2004. 374 p.

6. Shpaar D., Drager D., Kalenska S., Rakhmetov D. Renewable plant resources/ Monograph // St. Petersburg-Pushkin, 2006. T.1. 415 p.

7. Shpaar D., Drager D., Elmer F., Kalenskaya S. and others. Rapeseed and coleseed, Cultivation, harvesting, using. Kiev: ID "Zerno", 2012. 368 p.