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EFFECT OF FARMING PRACTICES ON PRODUCTIVITY OF MILK THISTLE UNDER CONDITIONS OF WESTERN FOREST-STEPPES

It is shown the results of research on the effects of row spacing, seeding rate and method of harvesting for field germination, plant survival and yield of milk thistle. We also presented the impact of terms of regulators application (pre-sowing seed treatment and spraying of growing plants in the phase of leaves socket) on stand density and yield of milk thistle.

Keywords: *row spacing, seeding rate, method of harvesting, growth regulator, germination, survival, yield capacity.*

Introduction. Today, growing of herbs is one of the most profitable sectors of agricultural production. But only integrated approach ensures success to the cultivation of these non-traditional crops [1], taking into account soil and climatic conditions of the region, the potential characteristics of plants, growing technology, harvesting, storage and processing of medicinal plants.

Currently, Ukraine and Russia provide themselves medicinal plants by only 15-25%, so it will not be specific competition in the cultivation of medicinal herbs in the next 10 years. Today, with changing climatic conditions, there is an opportunity to cultivate most species of medicinal and aromatic crops. In order to expand areas for medicinal plants in the forest-steppe zone, it is carried out a number of scientific and industrial researches on improving of farming practices relating to the growing of these crops according to climate and weather conditions. Milk thistle takes of one of the first places among the crops that require detailed study.

In different soil-climatic zones of Ukraine and neighboring countries it has been made a number of studies on the cultivation of milk thistle. It was studied the backgrounds of plant nutrition, terms of sowing, measures system of plants from weeds, diseases and pests.

In terms of Uman it was carried out the researches on the impact of growing conditions for sowing of seeds of milk thistle, it was paid the considerable attention to quality of seeds as the basis for reproduction, depending on soil and climatic conditions and planting effluents [2].

Investigation of the influence of backgrounds and seeding rate on the quality of the seeds of milk thistle in terms of the Middle Volga steppe is covered in writings of Kshnikatkina S.A. [3].

In terms of Saratov Right Bank it has been explored the impact of seeding rate, planting methods and doses of mineral fertilizers on productivity of milk thistle. The author claims that milk thistle need to be sown with a width of 30 cm of row spacing and seeding rate of 400 thousand of similar seeds per 1 hectare on the black soils of Saratov Right Bank, sowing should be done at the earliest possible time. The

maximum productivity of plants was obtained by making $N_{80}P_{40}K_{40}$ together with presowing processing of seeds with 0.05% boric acid solution [4].

It was set by the research of Glukhova L.V., that was carried out under the conditions of the Middle Volga steppe, that crops should be placed after Galega officinalis or made 3 t/ha of vermicompost to increase the production of seeds of milk thistle, seed should be treated and foliar feeding of crops should be conducted in phases of socket and bud-stimulating with liquid fertilizing composition (ZHUUSS-1) [5]

In the South of Ukraine on irrigated lands of Kherson it has been carried out the researches of the impact of the elements of growing technology on the productivity of milk thistle. According to Ushkarenko V.A. and Filipova I.M., fertilizers and terms of sowing have the greatest impact on plant productivity , share of voice is respectively: 39.2 and 26.2%, whereas row spacing and depth of tillage are less influential factors (3.3-53%). Thus, against the background of $N_{90}P_{90}$ during sowing at the end of March it was received the maximum yield of milk thistle seed – at 16.0 q/ha [6].

In the forest-steppe zone of Ukraine, milk thistle is grown on a small area, but recently with the change of weather and climate conditions , this culture is becoming more common.

Milk thistle is a very valuable crop. Thistle preparations are antioxidants, hepato protectors, membrane stabilizers, they have immunomodulating and restorative properties. Extending of the area under this crop will promote pharmaceutical companies with medicinal plants, and the execution of plan studies in different soil -climatic zones will help to form recommendations for the technology of its cultivation for the rational use of arable lands and obtaining the best possible productivity of plants.

The purpose and objectives of the research. The aim of the research was the justification of the basic principles of plant growth and development of milk thistle, formation of yields depending on the method of sowing, harvesting methods and the influence of plant growth regulators under western forest steppes.

Material and methods. Research was carried out during 2009-2013 at the experimental field of faculty of branch selection, seeding and general biological disciplines PSATU Ltd. «Obolon Agro» Chemerovetsky district Khmelnytsky region. Two experiments were held. In the first experiment it was studied three factors: A – row spacing (15, 30, 45 cm), B – number of plants per linear meter (50, 30, 10 units), C – cleaning methods (single-phase, two-phase). In a second experiment it was studied two factors: A – growth regulator (control (water) Agroemistim-extra (15 ml/m) (20 ml/ha), Ivin (15 ml/m) (20 ml/ha) Vermistim D (8 l/t), (10 l/ha), B – terms of treatment (seed treatment, crop spraying). All accounts, observations and analyzes were carried out according to conventional methods [7].

Results and discussion. Getting of full ladder is key to yield of any culture, including and milk thistle.

Field germination of different cultures varies greatly depending on soil and climate and weather conditions. When growing herbs it is need to be paid much attention to seed because the seeds of these plants are characterized by low seeding

properties. It is need to sow with varietal seeds of high reproductions; field germination should not be less than 85 % according to current standards.

Sprouting of milk thistle in our study ranged 88,3-93,2 %, it was identical to the number of plants - 206 thousand units per one hectare and 2 million 943 thousand units per one hectare of crops (*Table 1*).

Table 1

Stand density of milk thistle plants depending on row spacing and seeding rate, % (average for 2009-2013 years)

Row spacing, cm	Seeding rate th. units/ha	Field sprouting		Survival of plant	
		th. units. /ha	%	th. units. /ha	%
15	3.333	2.943	88,3	1.777	60,4
	1.999	1.839	92,0	1.279	69,3
	666	614	92,2	557	90,8
30	1.666	1.546	92,8	1.140	73,8
	999	929	93,0	810	87,2
	333	310	93,1	290	93,6
45	1.111	1.029	92,7	911	88,6
	666 (K)	620	93,2	561	90,6
	222	206	93,0	194	94,5
LSD $_{0,05}$, %		A – 0,80; B – 0,80; AB – 1,39		A – 1,50; B – 1,50; AB – 2,60	

Variants that were placed with greater density per unit area had lower germination compared with those that were sown with more feeding area.

The slightest sprouting 88.3 % is marked with sowing width 15 cm of row spacing and seeding rate of 3.333 thousand. per hectare. The greatest sprouting 93.2 % was provided with sowing at 45 cm with a given rate of sowing 666 units/ha. The difference between the options of wide row crops with width between rows 30 and 45 cm at different rates of seeding ranged 0.1-0.2 %.

An important indicator that determines the density of standing of plants at the end of the growing season is the percentage of survival, as during growing season some number of plants are damaged and dies as a result of environmental factors. Typically, the largest number of cultural species of plant, including milk thistle, died in the early period of growth – from germination to the formation of 5-6 rosette leaves.

Wide row crops with a given stand density 10 units per linear meter were characterized by more survival of plants, the figure was within 90,8-94,5 %. By the way, the control variant was characterized as one of the best indicators, which was 90.6%.

The lowest survival rate was 60.4 plants with continuous -row planting method with a given plant density of 50 units per linear meter. This low figure is explained by excessive thickness of milk thistle crops, which leads to competition between plants in the struggle for life factors.

The survival of plants is a very important parameter, since it is determined immediately before harvesting of plants and determines the yield based on the totality of all factors of influence. Study of the influence of growth regulators on the germination and survival of plants was performed at sowing with row spacing of 30 cm between rows and the number of plants per linear meter 10 units, that is, at a rate of seeding 333 thousands units per hectare. The data in *table 2* indicate that all preparations increased field germination of milk thistle at preliminary treatment of seeds, the rate ranged from 93,5-95,3%.

Table 2

Stand density of milk thistle plants depending on the application of growth regulators, % (average for 2010-2013 years)

Indicator	Treatment of seeds before sowing				Spraying of plants in the phase of leaves sockets			
	Control (water)	Agroemistim-extra	Ivin	Vermistim D	Control (water)	Agroemistim-extra a	Ivin	Vermistim D
Field sprouting units/ha	310	317	311	311	309	310	309	310
%	93,1	95,3	93,5	93,7	93,0	93,2	92,9	93,1
LSD $_{0,05,\ \%}$: A – 0,49; B – 0,35; AB – 0,70								
Survival of plants units/ha	291	308	298	298	291	235	293	295
%	94,0	97,3	96,1	96,0	94,2	95,4	95,0	95,2
LSD $_{0,05,\ \%}$: A – 0,48; B – 0,34; AB – 0,68								

As for the survival of plants, growth regulator Agroemistim-extra had the greatest influence on this rate, it is observed survival 97.3 % on the variant of seed processing of plants, whereas rate was 94.0 % in the control.

Thus, we can state the efficiency of influence of growth regulators at preliminary treatment of seeds, as good starting conditions associated with preservation of plants during the growing season, particularly their resistance to adverse environmental factors.

Productivity is the final score, which is the main criterion for evaluation of all farming practices and other impacts.

Accounting of productivity was conducted by area method from each variant of the experiment and it was determined the average of all repetitions. In our opinion, the horizontal distribution of plants over an area determines the fate of the future harvest, it is mainly governed by the rate of sowing and planting method. Therefore, the aim of the research was to identify the optimal ratio of row spacing and number of plants in a row to form a habit of plants that would be characterized by a large number of productive baskets with full seeds.

It should be borne in mind that the lateral roots of milk thistle have horizontal dimensions that are several times larger than the above-ground plant mass.

Table 3 highlights the effects of factors on the yield of milk thistle seeds in terms of years, when the study was performed.

Table 3

Yields of milk thistle seed depending on causal factors, t/ha

Row spacing, cm	Seeding rate, th. units/ha	Years					Average for years of research	± to control
		2009	2010	2011	2012	2013		
Single-phase harvesting (C)								
15	3.300	0,65	0,59	0,18	0,71	0,27	0,48	-0,62
	1.999	0,97	0,92	0,51	1,05	0,60	0,81	-0,29
	666	1,22	1,16	0,75	1,29	0,83	1,05	-0,05
30	1.666	0,88	0,83	0,42	0,96	0,51	0,72	-0,38
	999	1,20	1,13	0,73	1,27	0,82	1,03	-0,07
	333	1,88	1,80	1,46	1,79	1,47	1,68	0,58
45	1.111	1,0	0,97	0,57	1,10	0,66	0,86	-0,24
	666 (K)	1,24	1,21	0,81	1,34	0,90	1,10	-
	222	1,52	1,49	1,09	1,62	1,18	1,38	0,28
Two-phase harvesting (C)								
15	3.300	0,59	0,53	0,12	0,65	0,21	0,42	-0,68
	1.999	0,93	0,87	0,46	0,99	0,55	0,76	-0,34
	666	1,17	1,11	0,70	1,23	0,79	1,00	0,10
30	1.666	0,80	0,78	0,35	0,88	0,44	0,65	-0,45
	999	1,08	1,02	0,61	1,14	0,70	0,91	-0,19
	333	1,64	1,63	1,23	1,75	1,30	1,51	0,41
45	1.111	0,93	0,90	0,48	0,99	0,55	0,77	-0,33
	666	1,14	1,10	0,68	1,20	0,78	0,98	0,12
	222	1,24	1,21	0,82	1,34	1,09	1,30	0,2
$LSD_{0,05}$, th./ha A		0,09	0,10	0,08	0,10	0,07		
B		0,09	0,10	0,08	0,10	0,07		
C		0,08	0,08	0,06	0,08	0,06		
AB		0,16	0,16	0,13	0,17	0,12		
AC		0,13	0,14	0,11	0,14	0,10		
BC		0,13	0,14	0,11	0,14	0,10		
ABC		0,22	0,25	0,13	0,21	0,17		

Yields varied greatly depending on the weather, in 2011 and 2013 years, when there was some delay in sowing in 2011 – lack of moisture and consequently hostile and late shoots, 2013 – low soil temperature and the inability to access the field through the snowpack that in some places lasted almost to the end of the first decade of April.

Consequently, in 2011 and 2013 the yield of milk thistle seed, depending on the variant ranged 0,22-1,03 t/ha. Conditions of 2009, 2010 years were more favorable, and the highest rates of yield were obtained in 2012, in particular from 0.81 to 1.47 t/ha.

In average during the years of the research yield ranged from 0,58-1,68 t/ha. It is significantly dependent not only on structural indicators: number of seeds per plant

and weight, but also the number of plants per unit area, so evaluation of data indicates that on the analyzed variants by sprouting, survival, biometric and structural parameters, photosynthetic capacity stand density of plants per linear meter of 10 units and row spacing of 45 cm was better, and by productivity – 10 units of stand density and row spacing 30 cm.

Thus, the yield within 1,22-1,35 t/ha on the variants of solid crops was formed by stand density of plants at the end of the growing season 557 thousand units/ha, yield within 1,20-1,22 t/ha, that corresponded to broadly in-line method of sowing with row spacing of 45 cm with double lower seeding rate per hectare, was formed by the best indicators of crop structure: the number of seeds per plant 392.2 units, seed weight per plant – 9.0 grams. The highest yield of 1,51-1,68 t/ha was marked at sowing with a width of 30 cm of row spacing and seeding rate of 333 thousand units/ha, seed weight per plant for this variant was 8.6 grams , this is the best variant we tried to get as the result of the research.

As to the manner of harvesting, it single phase method was the best in which higher yield was obtained due to lower losses from the eruption of seed baskets. Thus, the resulting of two-phase harvesting compared with single-phase loss of productivity amounted to 0,02-0,17 t/ha, which was 1,9-11,5 %.

Yields of milk thistle may be increased due to the use of plant growth regulators. The data in *Table 4* demonstrates the effectiveness of the use of preparations that contribute to getting of yield supplement by 0,10-0,28 t/ha, where percentage value is 7,0-19,7.

Table 4

Yields of milk thistle depending on the application of plant growth regulators, t/ha

Years of reseach	Treatment of seeds before sowing				Spraying of plants in the phase of leaves sockets			
	Control (water)	Agroemistim-extra	Ivin	Vermistim D	Control (water)	Agroemistim-extra	Ivin	Vermistim D
2010	1,57	1,76	1,63	1,66	1,61	1,86	1,70	1,75
LSD $_{0,05}$, т/га: A – 0,02; B – 0,02; AB – 0,04								
2011	1,91	1,39	1,27	1,35	0,94	1,47	1,40	1,35
LSD $_{0,05}$, т/га: A – 0,06; B – 0,06; AB – 0,13								
2012	1,62	1,84	1,75	1,74	1,61	1,90	1,79	1,83
LSD $_{0,05}$, т/га: A – 0,03; B – 0,02; AB – 0,04								
2013	1,54	1,49	1,39	1,41	1,52	1,57	1,47	1,47
LSD $_{0,05}$, т/га: A – 0,04; B – 0,03; AB – 0,06								
Average for 2010-2013	1,41	1,62	1,51	1,54	1,42	1,70	1,59	1,60
± to control	-	+0,21	+0,10	+0,13	-	+0,28	+0,17	+0,18

Growth regulator Agroemistim-extra was the most influential in both methods of application, during preliminary treatment of seed yield increased by 0.21 t/ha, while crop spraying – by 0.28 t/ha. Results of analysis of variance showed that all received supplements by the application of growth regulators were authentic.

Conclusions. Yields of milk thistle are dependent on row spacing, number of plants per linear meter, method of harvesting, and weather conditions, the use of plant growth regulators. The highest yield of milk thistle seed has been provided by the variant that was sown with row spacing of 30 cm, seeding rate of 333 thousand units/ha in t harvesting by single-phase method, the rate has averaged 1.68 t/ha over the years of studies, which exceeded the control by 0, 58 t/ha.

Among the growth regulators that were used, Agroemistim-extra provided the greatest yield of 1.70 t/ha, supplement to control when spraying of crops amounted to 0.28 t/ha, which was 19.7%.

References

1. Hubanov, O. (2003). Vyroshchuvannia likarskykh roslyn sprava prybutkova [Cultivation of medicinal plants as a profitable business]. *Propozytsiia* [*Proposition*], *7*, 44-45 [in Ukrainian].

2. Kutsenko, O.M., & Marchenko, O. (2006). Vplyv umov vyroshchuvannia na posivni vlastyvosti nasinnia roztoropshi pliamystoi [Effect of growing conditions on milk thistle seed properties]. *Zbirnyk naukovykh prats Umanskoho derzhavnoho ahrarnoho universytetu* [Scientific Papers of Uman State Agrarian University], *63, 1*, 48-52 [in Ukrainian].

3. Kshnikatkin, S.A. (2003). Kachestvo syria rastoropshi piatnistoi v zavisimosti ot priemov vozdelyvaniia [The quality of raw milk thistle, depending on the methods of cultivation]. *Reguliatciia rosta, razvitiia i produktivnosti rastenii: materialy Mezhdunar. nauchn. konf.* [Regulation of growth, development and productivity of plants: Proceedings Intern. Scien. Conf]. Minsk, p. 70 [in Russian].

4. Samorodin, A.V. (2007). Produktivnost rastoropshi piatnistoi v zavisimosti ot norm vyseva, sposobov poseva i doz vneseniia mineralnykh udobrenii na chernozemnykh pochvakh saratovskogo Pravoberezhia [Productivity of milk thistle depending on seeding rates, sowing methods and doses of mineral fertilizers in chernozems of the Saratov Right bank]. *Candidate's thesis*. Orenburg [in Russian].

5. Glukhova, L.V. (2004). Ekologicheski bezopasnaia tekhnologiia vozdelyvaniia rastoropshi piatnistoi v lesostepi Srednego Povolzhia [Environmentally friendly technology of cultivation milk thistle in the forest-steppe of the Middle Volga region]. *Candidate's thesis*. Penza [in Russian].

6. Ushkarenko, V.O. (2013). Vplyv elementiv tekhnolohii vyroshchuvannia na produktyvnist roztoropshi na zroshuvanykh zemliakh Pivdnia Ukrainy [Effect of growing technology elements on milk thistle productivity on irrigated lands of southern Ukraine]. *Tavriiskyi naukovyi visnyk* [Tavria Scientific Bulletin], *83*, 110-115 [in Ukrainian].

7. Moiseichenko, V.F., & Yeshchenko, V.O. (1994). *Osnovy naukovykh doslidzhen v ahronomii* [*Fundamentals of scientific researches in agronomics*]. Kyiv: Vyshcha shkola [in Ukrainian].

Анотація

Хоміна В.Я.

Вплив агротехнічних заходів на врожайність розторопші плямистої в умовах Лісостепу західного

У статті висвітлено результати досліджень з вивчення впливу ширини міжрядь, норми висіву насіння та способу збирання на польову схожість, виживання рослин та урожайність розторопші плямистої. Показано також вплив строків застосування регуляторів (передпосівна обробка насіння і обприскування вегетуючих рослин у фазі розетки листків) на густоту стояння та урожайність розторопші плямистої

Ключові слова: *ширина міжрядь, норма висіву, спосіб збирання, регулятор росту, схожість, виживання, урожайність.*

Аннотация

Хомина В.Я.

Влияние агротехнических приемов на урожайность расторопши пятнистой в условиях Лесостепи западной

В статье приведены результаты исследований по изучению влияния ширины междурядий, нормы высева и способа сбора на полевую всхожесть, выживание растений и урожайность расторопши пятнистой. Показано также влияние сроков применения регуляторов роста (предпосевная обработка семян и опрыскивание вегетирующих растений в фазе розетки листьев) на густоту стояния и урожайность расторопши пятнистой.

Ключевые слова: *ширина междурядий, норма высева, способ сбора, регулятор роста, всхожесть, выживание, урожайность.*