№49/2020

Znanstvena misel journal

The journal is registered and published in Slovenia.

ISSN 3124-1123

VOL.1

The frequency of publication – 12 times per year.

Journal is published in Slovenian, English, Polish, Russian, Ukrainian.

The format of the journal is A4, coated paper, matte laminated cover.

All articles are reviewed

Edition of journal does not carry responsibility for the materials published in a journal.

Sending the article to the editorial the author confirms it’s uniqueness and takes full responsibility for possible consequences for breaking copyright laws

Free access to the electronic version of journal

Znanstvena misel journal

Slovenska cesta 8, 1000 Ljubljana, Slovenia

Email: info@znanstvena-journal.com

Website: www.znanstvena-journal.com

CONTENT

AGRICULTURAL SCIENCES

BIOLOGICAL SCIENCES

ECONOMICS

PHILOLOGY

PSYCHOLOGICAL SCIENCES

AGRICULTURAL SCIENCES

MOISTURE SUPPLY UNDER MEADOW CLOVER CROPS

Zabarna T.
Vinnytsia National Agrarian University
Vinnytsia

Abstract

One of the key factors of sustainable further development of the livestock industry in Ukraine, especially dairy cattle breeding, is the formation of an appropriate high-quality fodder base. The basis for solving this issue is the availability of intensive high-productive varieties of meadow clover, adapted to specific soil and climatic conditions and able to ensure the production of quality forage. Perennial leguminous grasses play a key role in meeting this challenge.

Perennial grasses, especially legumes, along with formation of high-protein forage, participate in biological farming, because they provide the soil with organic matter and biological nitrogen, stabilizing its fertility and in general positively influence the state of the environment.

It is generally accepted that in the structure of sown areas of Ukraine, the share of perennial leguminous grasses varies in the range of 50-75%.

The forest-steppe zone of Ukraine, which also include the territory of Vinnytsia region, occupies 202.8 thousand km^2 or 33.6% of the total area, where about 43% of gross agricultural production is produced. The prospect of the development of this region is considered to be high productive cattle breeding, development of meat and dairy branches of productivity. In order to increase the production, decrease the prime cost of fodder and improve its quality, it is necessary to improve the structure of areas sown with fodder grain and fodder crops, to implement and develop special forage crop rotations with the maximum saturation of leguminous crops.

Despite the indicators of the formation of high fodder productivity and significant protein collection, the value of meadow clover lies also in its ability to provide nitrogen nutrition for its own needs, passes through symbiosis with nodule bacteria, and the stable high nitrogen content in the residues of roots makes it possible to increase its share in the soil, turning meadow clover into a productive precursor. Furthermore, the seeds of perennial grasses, including clover, are in sufficient demand on foreign markets as a source of foreign exchange earnings.

However, the current traditional technology of meadow clover cultivation does not ensure the full use of the crop's potential. Therefore, the development of new and improvement of existing technological methods of growing clover meadow for green fodder, is important national economic importance and requires adequate scientific justification in the soil and climatic conditions of the Vinnitsa region.

Many years of research and practice proved the prospects of growing popular and widespread in the world of clover meadow. Over the past years of transformation of the agricultural sector in Ukraine significantly reduced the area of cultivation of perennial leguminous grasses, including clover meadow. It is well known that the leaf mass of meadow clover is characterized by high digestibility, high content of vitamins, especially carotene and minerals. In the field rotation it plays an important agrotechnical significance, provides the soil with organic matter and biological nitrogen, improves its structure, and is also an excellent precursor for subsequent crops of the rotation.

The article reflects the results of the research, which prove that the optimization of the conditions of mineral nutrition in the dose ($P_{60}K_{90}$) of meadow clover grasses promoted the rational use of productive moisture from the soil in the formation of meadow clover grasses. It resulted in the decrease of water consumption factor in comparison with the control variant by 33,0-34,3% in the second year of life and by 25,0-27,9% in the third year of life of meadow clover.

Keywords: clover meadow, moisture, productivity, variety, mineral fertilizers, climate, moisture consumption.

Meadow clover is considered to be the best fodder crop for animals. It is used to make vitamin fodder, silage, haymeal and green matter. The root system of clover, when the above-ground part of the plant is mown, becomes an ideal fertilizer as it starts to actively accumulate nitrogen and saturate the soil with this important element. This is why experienced gardeners intentionally sow clover in order to enrich and improve its fertility. Meadow clover is well known to beekeepers as an excellent honey bee, so bees can collect nectar and pollen from it throughout the summer and until the end of September [1].

When using intensive cultivation technologies for all crops in a crop rotation, it is the sowing of perennial grasses that is the main determinant of reducing the cost of crop production and obtaining sustainable high yields of forage crops by introducing into the cycle of biological nitrogen fixed from the atmosphere. It is well known, that the main biological feature of all perennial grasses is their longevity in herbage, besides fast vegetative regrowth after mowing and high adaptability to the conditions of cultivation of crops and increasing of soil fertility.

V. Pereguda adds that the green mass of perennial grasses is used to make hay and haylage, which are so necessary for feeding all kinds of farm animals, as well as balanced in all nutrients. In addition, perennial grass seeds are in demand on foreign markets, which generates foreign exchange earnings. One should also take into account such a biological factor as improvement of soil structure and increase of its fertility by enriching it with available nitrogen [2,3].

To date, Ukraine is one of the main areas where high yields of meadow clover are grown and obtained. Clover is very valuable fodder crop, allows you to balance the protein content of carbohydrate fodder, contains almost all essential amino acids, including the most important - lysine, methionine, tryptophan. Under favorable growing conditions, a two-year application of meadow clover accumulated 4.06-4.08 t/ha of dry root mass in the soil, containing 83.7-84.3 kg of nitrogen, 24.4-24.5 kg of phosphorus, and 51.1-51.4 kg of potassium. The application of phosphorus-potassium fertilizers at the rate of $P_{60}K_{90}$ and inoculation contributed to the maximum productivity of meadow clover grass. On the non-tillage crops the green mass yield was 30,20-32,06 t/ha with the yield of 6,24-6,59 t/ha of dry matter. In the sub-covered crops the productivity values in accordance varied between 31.14-32.97 and 6.29-6.61 t/ha [4].

Scientists recommend that in order to increase the production of quality high-protein plant resources in Ukraine, it is worth expanding the sown areas of perennial leguminous grasses, as well as improving their cultivation technology for fodder purposes in different regions. It is through this that the need for fodder protein can be almost completely satisfied [5]. Therefore, first of all, it is necessary to increase the area sown with perennial grasses in the total structure of fodder crops to about 50-60%, without which it is actually impossible to balance the group of fodder crops in terms of digestible protein content [6].

The problem of supplying moisture to all crops is now an acute one for farmers all over the world and is quite urgent. The climate has been changing very rapidly in recent years, and seasons with extremely low rainfall are disastrous for farmers. The problem of soil moisture supply is systemic and profound and needs to be addressed urgently. Because soil moisture availability is directly related to its structure, tillage method and ultimately affects the overall improvement of fertility.

Water is a plant temperature regulator: moisture evaporates through the leaves, lowering the temperature and preventing the plants from overheating. About 0.2 to 0.3% of the water absorbed by plants is used to build up plant mass, and over 99% is evaporated, providing a transport role and a heat-protective effect. The evaporation of water by leaves and other above-ground organs is called transpiration. Transpiration creates a force in the cells of the leaves that ensures the transport of water and the substances dissolved in it from the roots to the leaves. If the plant evaporates more water than takes it up from the soil, it loses turgor and withers. In such a plant, photosynthesis is reduced and the processes of hydrolysis and decomposition of organic matter are intensified, so that the coordination of enzymes is disrupted. For many cultivated plants, moisture in the arable soil layer (0-20 cm), where the main mass of the root system is located, is of great importance. A decrease in productive moisture in this layer of less than 20 mm begins to have a negative impact on yield formation.

For optimal biological processes the agricultural plants need a certain amount of assimilated moisture [7].

The productive moisture in the soil is the main source of crop watering. The productive moisture is understood as that part of soil moisture, which is contained in the soil in forces not exceeding the suction power of the root system of plants, creates optimal conditions for watering the cells of the plant organism and is used by them to maintain vital functions and synthesis of organic matter [8].

Numerous publications of scientists confirm that an important factor in increasing crop yields is the rational consumption of productive moisture reserves. It is known that it is possible to increase the efficiency of soil moisture use by optimizing the conditions of mineral nutrition and improving the water and physical properties of the soil, provides an intensive use of productive moisture from deep soil layers and reducing its losses on physical evaporation [9,10].

Soil water regime is directly dependent on the following factors, namely the amount and frequency of precipitation, solar energy, soil temperature, air temperature and many other agrometeorological factors. However, the crops themselves affect the formation of the water regime of the soil: the root system determines the absorption of water from the soil and its transportation to the vegetative and generative organs of the plant and the formation of plant tissues the above-ground mass produces its microclimate, directly affecting the operation of meteorological factors [11].

The indicator of water content in plant organs determines the intensity of physiological and biochemical processes, enzymatic activity of plants and their growth and development.

In perennial legume grasses, such as alfalfa and meadow clover, with increasing temperature and light the intensity of transpiration increases and reaches a maximum during the formation of 3-4 true leaves. During the period of pogonovutvoreniya this indicator decreased, and at the onset of the phase of budding it increases again, while at the time of flowering the consumption of moisture by plants decreases again. If perennial legumes are not properly supplied with moisture, the intensity of the pagoneutvival process stops or weakens, and the number of growth buds on the root neck of the plants decreases. As a consequence, the delay of vegetative regeneration has a detrimental effect on the dynamics of leaf mass accumulation [12].

Researchers have established that the optimal condition for meadow clover corresponds to the state of soil moisture, when its pores are 88% filled with water and 12% with air [13].

I.S. Shatilov adds that the best conditions for meadow clover are created at 89% NV during sprouting-early flowering, 60% during flowering and 40% during seed ripening [14]. Yield also depends on the distribution of moisture relative to the phases of development, the moisture becomes a limiting factor in the formation of yield [15].

According to Ulanova E.S. and Zabelin V.M., soil moisture occupies an important place among the main factors that ensure the growth and development of agricultural plants. Its optimal level during the growing season guarantees high and sustainable crop yields. The provision of moisture to crops during the growing season is estimated by its availability in the soil [16].

Adapted to the conditions of the environment varieties allow maximum use of the growing season, soil fertility, mineral nutrition, irrigation conditions, drought tolerance, winter hardiness, as well as successfully withstand adverse stress factors. Therefore, two varieties of meadow clover of local selection, Sparta and Anitra, were selected for the study. The cover crop was barley of the variety Sobornyi.

After harvesting the forecrop (winter wheat for grain) the stubble was tilled followed by under-winter plowing to a depth of 25-27 cm. Pre-sowing preparation included tilling to a depth of 10-12 cm followed by mineral fertilizer application. The soil was levelled and compacted with a combined unit, after which seeding was carried out. The sowing rate of meadow clover was 9.0 and spring barley 2.0 mln. pcs. of germinated seeds / ha respectively. Before sowing the meadow clover seeds were prinoculated with a bacterial preparation. After sowing the crops were rolled with ring-spiked rollers.

Meadow clover was harvested for green fodder in the phase of early flowering and barley for grain in the phase of full grain ripeness.

The laying and field studies were conducted in accordance with the generally accepted methods [17,18].

Since the moisture content in the soil is an important indicator affecting the vital activity of plants of meadow clover of the first year of life, therefore, we intended to study the dynamics of productive moisture content in its crops. Our research on the dynamics of stocks of productive moisture showed that on average over the years of research, at the time of sowing of clover meadow in uncovered and undercover crops stocks of productive moisture in the soil layer 0-50 cm were within 95.1 mm.

During the life activity of meadow clover plants, stocks of productive moisture in the soil varied due to the moisture regime of the region and the amount of precipitation (Table 1).

As a rule, the stocks of productive moisture in grass stands of meadow clover under the cover of spring barley should be lower in comparison with uncovered crops. Our study of stocks of productive moisture in the soil layer 0-50 cm showed that in the conditions of the region on grey forested silty loam soils there is little difference between the covered and uncovered crops.

This can be explained by the fact that the number of meadow clover plants in uncovered crops was slightly higher and they were better developed, and therefore in the process of their life activity they more intensively used the reserves of productive moisture for the formation of the leaf-stem mass yield.

Whereas stocks of productive moisture in the period of full sprouts of clover meadow, for variety Sparta were in the range 96.5-101.4 mm - in non-tillage cultivation and 96.2-100.9 mm - in sub-tillage.

Indicators of stocks of productive moisture under grasses of meadow clover variety Anitra were at the level of 91.3-96.3 mm - at uncovered cultivation and 91.0-95.8 mm - at undercover cultivation.

Table 1

Dynamics of productive moisture reserves in soil under crops of meadow clover of the first year of life in the layer 0-50 cm, mm (Average for 2016-2017)

Fertilizer	Landless cultivation			Groundcover cultivation		
	full sprout	Emergence from under the cover	Cessation of vegetation	full sprout	Emergence from under the cover	Cessation of vegetation
Sparta						
Without fertiliser (control)	101,4	28,4	49,4	100,9	27,2	47,6
Inoculation	99,5	27,6	47,1	99,2	26,3	46,6
Inoculation + $P_{60}K_{90}$	98,3	25,8	44,8	98,1	24,9	43,8
Inoculation + $N_{60}P_{60}K_{90}$	96,5	22,7	41,7	96,2	22,3	40,1
Anitra						
Without fertilizer (control)	96,3	26,4	45,0	95,8	24,6	43,5
Inoculation	94,4	25,0	43,0	94,1	23,7	42,5
Inoculation + $P_{60}K_{90}$	93,1	23,2	41,6	92,9	22,4	41,0
Inoculation + $N_{60}P_{60}K_{90}$	91,3	21,4	38,3	91,0	20,2	37,1

At the time of harvesting barley for grain the amount of productive moisture in the under- and uncovered crops differed. Thus, in uncovered crops, on the variants without fertilizer, stocks of productive moisture amounted to 26.4-28.4 mm.

Upon application of clover seeds inoculation, the content of productive moisture in the soil layer 0-50 cm was 25,0-27,6 mm, while on the plots with the application of mineral fertilizers in the rate of $P_{60}K_{90}$ the stocks of productive moisture were 23,2-25, 8 m3/ha.

The least stocks of productive moisture were (21.4-22.7 m3/ha) on the variants with the application of full mineral fertilizers, which is explained by intensive use of water during formation of the leaf mass yield.

The content of productive moisture in the soil of meadow clover under crops on the variants without fertilization was 24.6-27.2 mm, while under inoculation it was 23.7-26.3 mm.

On meadow clover herbage, where phosphorus-potassium fertilizers and pre-sowing seed inoculation with bacterial preparation were applied, stocks of productive moisture in the soil layer 0-50 cm were 22,4-24,9 mm. At application of full mineral fertilizer in norm $N_{60}P_{60}K_{90}$ during the pre-sowing cultivation these reserves in the soil were the least and amounted to 20,2-22,3 mm.

At the end of vegetation meadow clover in the first year of life stocks of productive moisture were in the range 41,7-49,4 mm for variety Sparta at non-tillage cultivation and 40,1-47,6 mm - at under-tillage cultivation.

At the same time the stocks of productive moisture in the soil layer 0-50 cm under meadow clover herbage of the variety Anitra were between 38.3-45.0 mm for non-tillage crops and between 37.1-43.5 mm for under-tillage crops.

We found that the processes of the formation of the leaf-stem mass of meadow clover in the second and third years of life were influenced by both the equal mineral nutrition and the ways of growing of meadow clover and by the varieties and the level of soil provision with productive moisture.

It was noted that at the time of renewal of spring vegetation of plants of meadow clover of the second year of life, the amount of productive moisture in the soil layer 0-100 cm was 165,1-170,4 mm (Table 2).

At cultivation of a clover meadow variety Sparta on variants without application of mineral fertilizers for the period of slope ripening the content of productive moisture in the soil was 144,6-148,1 mm, and at the time of the second cutting only 89,6-91,8 mm.

Table 2

Stocks of productive moisture under grasses of meadow clover Sparta variety of the second year of life in the 0-100 cm layer, mm (Average for 2017-2018)

Fertilizer	Growing method	Regrowth	1 Grass stand slope	2 Grass stand slope
Without fertilizer (control)	landless	170,4	148,1	91,8
	groundbreaking	168,0	144,6	89,6
Inoculation	landless	169,7	143,8	89,8
	groundbreaking	166,8	140,4	87,7
Inoculation + $P_{60}K_{90}$	landless	166,9	135,1	83,2
	groundbreaking	167,4	130,5	80,9
Inoculation + $N_{60}P_{60}K_{90}$	landless	168,8	139,4	87,0
	groundbreaking	167,1	134,4	83,1

When growing meadow clover cultivar Anitra under similar conditions stocks of productive moisture were 141,6-145,5 and 87,390,2 mm respectively.

The lowest rates of productive moisture in the soil, at the collection of leaf mass of meadow clover were observed in the variants with the introduction of phosphorus-potassium fertilizer ($P_{60}K_{90}$) in the pre-sowing cultivation and the use of rhizotorfin. Thus, during the first cutting of clover grass Sparta the reserves of productive moisture in the soil were 130,5-135,1 mm and during the second cutting 80,9-83,2 mm.

The stocks of productive moisture in the soil layer 0-100 cm at the time of renewal of spring vegetation of meadow clover of the third year of life on the average on the experience were in the range 183,1-189,2 mm (tab. 3).

On the average for the variants without the application of mineral fertilizers the stocks of productive moisture at the time of the first cutting were 185,7-189,2 mm and at the time of the second cutting they were 158,3-163,5 mm.

Table 3

Stocks of productive moisture under grasses of meadow clover Sparta variety of the third year of life in the layer 0-100 cm, m3 /ha (Average for 2018-2019r.)

Fertilizer	Growing method	Regrowth	1 Grass stand slope	2 Grass stand slope
Without fertilizer (control)	landless	189,2	163,5	140,3
	groundbreaking	186,4	159,7	136,8
Inoculation	landless	188,7	158,4	135,7
	groundbreaking	185,8	155,1	133,9
Inoculation + $P_{60}K_{90}$	landless	185,4	146,8	130,4
	groundbreaking	183,6	141,3	126,7
Inoculation + $N_{60}P_{60}K_{90}$	landless	187,5	152,2	134,8
	groundbreaking	184,3	147,5	128,2

At carrying out of the pre-sowing inoculation of clover seeds the content of productive moisture under grasses of both varieties was 185,3-188,7 mm during the first cutting and 151,2-158,4 mm - during the second cutting.

As the meadow clover cultivars formed the highest yield of leafy mass on the variant with P60K90 application and seed inoculation the content of productive moisture was correspondingly lower as compared with other variants. Thus, during the first cutting the moisture content was 183,1-186,7 mm and during the second cutting it was 139,6-146,8 mm.

In the third year of life of meadow clover, at application of N60P60K90 to pre-sowing cultivation stocks of productive moisture in the soil layer 0-100 cm during the first mowing were 183.7-187.1 mm, while during the second mowing they were in the range 145.6-152.2 mm.

For more objective estimation of use of stocks of productive moisture of soil, at formation of a crop of leafy mass of clover meadow, except for definition of stocks of productive moisture we also calculated indicators of the total water consumption and coefficient of water consumption.

To determine the total water consumption, we determined the difference of moisture reserves at the time of sowing and at the time of harvesting, and then to this indicator we added the amount of precipitation that fell during this time.

The water consumption coefficient is defined as the ratio of total water consumption to crop yield in absolutely dry matter.

It should be noted that the indicators of total water consumption of meadow clover plants during the growing season depended to a large extent on the levels of mineral nutrition and the method of cultivation in the first year of life (Table 4).

Thus, in uncovered crops, on the variants without fertilizer, the indicators of total water consumption were 256 m3 /ha, while in undercover crops - 256-258 m3 /ha.

The use of seed inoculation when sowing meadow clover, on average for the experiment, increased the total water consumption ratios by 234-232 m3/ha - in no-till crops and by 256-263 m3 /ha.

When P60K90 was applied in pre-sowing cultivation with inoculation the values of total water consumption on uncovered crops were 262-264 m3/ha and on under-covered crops were 262-263 m3/ha.

Under the condition of the introduction of full mineral fertilizer in the rate of $N_{60}P_{60}K_{90}$ with the pre-sowing seed inoculation the total water consumption of the meadow clover varieties without grass cover was 260-261 m3/ha, and in the grassland - 261-263 m3/ha.

In the course of the research, it was found that the higher the water consumption factor of meadow clover during the growing season was noted on the control variant. Thus, for the variety Sparta in uncovered crops it was 565, and in undercover - 557.

Table 4

Total water consumption and water consumption coefficients of meadow clover in the third year of life depending on fertilizer and cultivation method (average for 2018-2019 yr.)

Variety	Fertilizer	Growing method	Total water consumption during vegetation, m3 /ha	Water consumption coefficient per vegetation
Sparta	Without fertilizer (control)	landless	230	734
		groundbreaking	230	722
	Inoculation	landless	234	726
		groundbreaking	233	720
	Inoculation + $P_{60}K_{90}$	landless	236	574
		groundbreaking	238	570
	Inoculation + $N_{60}P_{60}K_{90}$	landless	234	635
		groundbreaking	237	627

The coefficient of water consumption of meadow clover variety Anitra during the growing season was 535 in uncovered crops and 528 in undercover crops.

The most economically productive moisture is used by meadow clover crops on the variants with the application of $P_{60}K_{90}$ to the pre-sowing cultivation with the pre-sowing inoculation of seeds with a bacterial preparation. Under these growing conditions the water consumption coefficient of meadow clover variety Sparta was 421 in uncovered crops and 417 in sub covered crops. That is, these values were close for the variety Sparta in the third year of life.

In uncovered cultivars of meadow clover cultivar Anitra the water consumption factor in the third year of life was 400, and in undercover cultivars it was 397 - subject to the application of phosphorus-potassium fertilizer and seed inoculation.

It should be noted that the indices of total water consumption in the third year of life were slightly lower than in the second year, while the indices of water consumption coefficient, on the contrary, tended to increase.

On the control variant under cultivation of meadow clover variety Sparta in uncovered crops the total water consumption during the growing season was 230 m3/ha, while the water consumption coefficient was 734. Under similar growing conditions for the meadow clover variety Anitra, the total water consumption and the water requirement factor per vegetation were 231 m3/ha and 666, respectively.

Under the sub cropping method of meadow clover cultivation on the variant without fertilization the total water consumption of the variety Sparta was 230 m3 / ha, and of the variety Anitra - 231 m3/ha, with the coefficients of water consumption were respectively 722 and 652.

It should be noted that when using phosphorous-potassium fertilizer ($P_{60}K_{90}$) in pre-sowing tillage the indicators of the total water consumption for meadow clover varieties without grass cover were 236-240 m3/ha, while in sub-grass crops they were 238-240 m3/ha. At the same time, for uncovered cultivars of meadow clover the water consumption coefficient was 527-574, and for undercover cultivars it was 521-570.

Thus, it was found that the optimization of the conditions of mineral nutrition ($P_{60}K_{90}$) of meadow clover grasses contributed to the rational use of productive moisture from the soil in the formation of the leaf mass. It resulted in the reduction of water consumption factor in comparison with the control by 33,0-34,3% in the second year of life and by 25,0-27,9% in the third year of life of meadow clover.

References

1. Electronic resource: https://agrostory.com/ua/info-centre/fans/klever-lugovoy-krasnyy/
2. Electronic resource: https://propozitsiya.com/ua/bagatorichni-travi
3. Petrychenko V. F. Obgruntuvannia tekhnolohii vyroshchuvannia kormovykh kultur ta enerhozberezhennia v polovomu kormovyrobnytstvi / V. F. Petrychenko // Visnyk ahrarnoi nauky. – 2003. № 10. Spetsvypusk S. 6–10.
4. Zabarna T. A. Vplyv siianykh travostoiv koniushyny luchnoi na nahromadzhennia korenevoi masy ta zminu fizyko-khimichnykh pokaznykiv rodiuchosti gruntu Polish journal of science. - 2020. - № 26. - P. 3-8.
5. Poberezhna A. A. Ekonomichni problemy svitovykh vysokobilkovykh roslynnykh resursiv / A. A. Poberezhna // Kormy i kormovyrobnytstvo. 2003. Vyp. 50. S. 49–54.
6. Petrychenko V. F. Teoretychni osnovy intensyfikatsii kormovyrobnytstva v Ukraini / V. F. Petrychenko // Visnyk ahrarnoi nauky. 2007. № 10. S.19–22.
7. Electronic resource: https://pidruchniki.com/1352061262645/tovaroznavstvo/vologozabezpechennya_kultur
8. Verigo S. A. Pochvennaya vlaga: monografiya. S. A. Verigo, L. A. Razumova. L: Gidrometeoizdat, 1973. 328 s.
9. Proizvodstvo i ratsionalnoe ispolzovanie kormovogo proteina / Pod. red. I. P. Proskuryi. K.: Urojay, 1979. 408 s.
10. Nemtsov N. S. Izmenenie moschnosti korneobitaemogo sloya i produktivnosti selskohozyaystvennyih kultur v zavisimosti ot doz udobreniy i glubinyi ih zadelki / N. S. Nemtsov, V. I. Karagin, A. A. Moiseev i dr. // Dokladyi Rossiyskoy akademii selskohozyaystvennyih nauk. 2002. № 1. yanvar – fevral. S. 20–22.
11. Zabarna T. A. Vplyv hidrotermichnykh umov na kormovu produktyvnist koniushyny luchnoi v umovakh pravoberezhnoho Lisostepu / T. A. Zabarna // Zbirnyk naukovykh prats VNAU. № 10 (50). 2012. S. 85–90.
12. Kvitko H. P. Bahatorichni bobovi travy – osnova pryrodnoi intensyfikatsii kormovyrobnytstva ta polipshennia rodiuchosti gruntu v Lisostepu Ukrainy . Kormy i kormovyrobnytstvo. 2012. Vyp. 73. S. 113-117.
13. Babych A. O. Svitovi zemelni, prodovolchi i kormovi resursy. / A. O. Babych. K.: Ahrarna nauka, 1996. 570 s.
14. SHatilov I. S. Printsipyi programmirovaniya urojaynosti. Programmirovanie urojaev s.-h. kultur: Nauch. tr. VASHIIL / I. S. SHatilov. M.: 1975. S.7–17.
15. Electronic resource: https://www.agronom.com.ua/osoblyvosti-vologozabezpechennya-kukurudzy/
16. Ulanova E.S., Zabelin V.N. Metodyi korrelyatsionnogo i regressionnogo analiza v agrometeorologii. L.: Gidrometeoizdat, 1990. 207s.
17. Dospehov B. A. Metodika polevogo opyita / B. A. Dospehov M.: Agropromizdat, 1985. 347 s.
18. Metodyka provedennia doslidzhen po kormovyrobnytstvu / Pid red. A.O. Babycha. Vinnytsia. 1994. 87 s.

VOL.1

№49/2020

Znanstvena misel journal

The journal is registered and published in Slovenia.

ISSN 3124-1123

The frequency of publication – 12 times per year.

Journal is published in Slovenian, English, Polish, Russian, Ukrainian.

The format of the journal is A4, coated paper, matte laminated cover.

All articles are reviewed

Edition of journal does not carry responsibility for the materials published in a journal.

Sending the article to the editorial the author confirms it's uniqueness and takes full responsibility for possible consequences for breaking copyright laws

Free access to the electronic version of journal

Znanstvena misel journal

Slovenska cesta 8, 1000 Ljubljana, Slovenia

Email: info@znanstvena-journal.com

Website: www.znanstvena-journal.com