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MEDIC PRODUCTIVITY DEPENDING ON SEEDING RATE IN RIGHT BANK FOREST-STEPPE OF UKRAINE

V. KOVALENKO, candidate of agricultural sciences, associate professor

National University of Life and Environmental Sciences of Ukraine

E-mail: kovalpower@bigmir.net

Abstract. *The author covers an issue of medic productivity, determines the issue of seed preparation for planting, timing and methods of sowing depending on different seed rates in the Right-Bank Forest-Steppe of Ukraine. It was found that the formation of optimum stand density and yield of alfalfa leaf and stem mass are affected by seeding rate, sowing methods, the quality of soil preparation, seeding depth, humidity and varietal identity.*

Key words: *medic, seed preparation, timing of sowing, methods of sowing, leaf and stem mass, dry matter*

Alfalfa is one of the oldest fodder crops, which was grown about 5 thousand years ago in the countries of East and Africa. Its seeds, just like seeds of sainfoin and wheat, were found in the Egyptian Pyramids. There is no consensus concerning alfalfa appearance in Ukraine: some researchers think that it was brought from Europe, in turn, there it was brought from Russia. Wild alfalfa still can be found in Caucasus, Middle Asia, and Russia. The other point of view had Hugo Verner, who thought, that alfalfa was brought to Russia from Tibet, and then got to Europe. So, alfalfa was brought by several ways to Ukraine. According to many European and native scientists, alfalfa was grown far before the Common Era in China, India, Persia, Egypt and other countries (Zinchenko, Demydas, Sichkar 2013), (Malyi 1994).

Scholars of those times accentuated its versatile use. Thus, according to Plinius the elder, it manures fields, feeds livestock, is a remedy and provides high productivity.

The history of the name of the crop (“lutserna” in Ukrainian) is quite interesting. In ancient Greece it was called “medikai” (after Midia – the name of

Persia), in ancient Rome – “herbamedika”, in France – “Italian claucerna”. There is an idea that the name of the plant comes from the valley “Lutserna” in Piedmont, which gave to the plant the name “lutserta” or “lutserna”. In Spain the crop was called “latsuzerda”, which in France was transformed into “lutserta”, which in its turn was transformed into “lutserna”. So, it is impossible not to note the relationship between abovementioned names of the crop, which affirms its quick expansion over European countries. There is information, that in XVI – XVII centuries, alfalfa was brought to the New World (Zinchenko, Demydas, Sichkar 2013), (Malyi 1994).

World experience of fodder production organizing in terms of intensive animal breeding shows that reliable way of increasing production of high-protein feed is to improve the structure of cultivated area under fodder-grain, pulse and fodder crops. Of particular note is the forage production of perennial legumes that seamlessly combine high productivity with a high content of digestible protein balanced according to amino acid composition (Zinchenko, Demydas, Sichkar 2013), (Kvitko, Nazarov 1988).

The world leader according to collection of digestible protein and essential amino acids per hectare among perennial legumes is alfalfa (Kvitko 1990).

The EU countries have begun large-scale production of valuable proteins from alfalfa, which contains no cholesterol. The new protein, called *ribisco*, can substitute soy in some food products, particularly in sausage, sauces and chocolate mousse. In its value this protein is not inferior to cow's milk protein. The technology of getting protein from alfalfa was developed by Swedish concern Alfa-Laval. There is a plant for production of the mentioned protein in France, which is owned by France Luzerne. The firms from the U.S., Canada and Saudi Arabia are interested in technology for producing protein from alfalfa. The production of this product has particular significance for countries of European Union, as reduces their dependence on imported soybeans. Alfalfa protein can be used in feed for cattle without any risk of infecting with mad cow disease. The introduction of technology for a new type of protein opens up new opportunities for farmers, because growing alfalfa is relatively

harmless to the environment as this crop does not require nitrogen fertilizers, and requires minimum of herbicides (Malyi 1994), (Dieter Shpaar 2011).

Over the last few years they were observed extremely adverse weather conditions for wintering of perennial legumes, which, unfortunately, had really negative impact on wintering plants last fall and winter. As a result of a sharp drop in temperature in November and December, took place after a long rainy period in September and October, large areas of red clover fell or were extremely thinned. This was caused by several periods of formation of thick (8-10 cm) coating of ice on the fields' surface. And above all expectations, in terms of almost complete freezing of red clover, the black medic survived in winter tempest and wintered quite well.

The potential yield of alfalfa in terms of dryland growing is 35-45 tons of herbage per hectare, in terms of irrigation - 80-150 t/ha. However, in our case, this figure stands at 25-35 t/ha, caused by non-following growing technology and sudden changes of weather conditions during the growing season. Thus, it arises the need in technological improvement of existing measures and development of new technologies designed to increase productivity and obtain high-quality, environmentally - friendly, high energy cheap food (Demydas, Ivanovska, Golubev 2011).

An important element of growing technology is the norm of alfalfa seeding and stand density of plants, which influence yield value and general productivity of grown crop seeds (Malets 1983) (Sevidov 2004).

Numerous studies proved that stand density strongly depends on the similarity of fields and varies depending on seeding rate, sowing methods, varietal and sowing qualities of seeds, soil and climatic conditions, supply of nutrients (Moyseenko, Tkachenko 1990) (Petrychenko, Kvitko 2010).

According to many literary sources, alfalfa seeds contain a lot of weeds in the first year of vegetation, resulting in competition for nutrition elements and reducing yield of aboveground mass. Therefore, obtaining good sprouts and saving them during the growing season are among the most important preconditions for formation of the optimal seed structure and crop yields with high quality indices.

It was established, that thick alfalfa planting does not provide high yields in most cases. Alfalfa is a light demander and its shading with cover crop or weeds weakens it dramatically. In such seeds the plants become drawn and the degree of their leafiness reduces significantly, leading to coarsening of the stem and decrease in fodder quality (Sneehovoy 1989). According to many scientists, it is known that productivity of individual plant increases in terms of broadening of feeding area and decreases in terms of its reduce. This can be explained by worse lightning, water and nutrient supply (Synyahyn 1975).

Materials and methods. Research was carried out in accordance to conventional methods of crop rotation in fodder production and melioration at Agronomic Research Station (ARS) of the National University of Life and Environmental Sciences of Ukraine (NULES of Ukraine), which is located in the village Pshenychne, Vasylkiv district, Kyiv region, that is the Right-Bank Forest-Steppe of Ukraine.

Soil of the research field is typical low mid-humic coarse-slit black soil on loess. The humus content in the plough layer according to Turin is 4.34-4.68%, pH of salt extraction – 6.8-7.3, absorption capacity – 30.7-32.5 mg equiv per 100 g of soil. The structure of the mineral soil solid phase contains 37% of natural clay and 63% of sand.

Weather conditions in vegetation and wintering periods were satisfactory during research years, but notable for contrast in water and temperature regimes when compared to average long-term indices. Changes in temperature and winter thaws caused the formation of ice cover, influencing negatively impact on wintering conditions and leading to the loss of alfalfa out of the stand. Spring and summer growing season also saw sharp drops and prolonged high temperatures in April, May and June (2007, 2008, 2009.) Downfall value in April 2007 was 3 mm and in April 2009 – 0 mm, while the average long-term index is 46 mm.

The sum of effective temperatures (over 10^0C) during the growing season was 3167^0C against the average long-term one - 2635^0C.

Mineral phosphorus-potassium fertilizers were applied during primary tillage under planned yield in the form of 20% granulated superphosphate and 56% potassium chloride.

Alfalfa was grown on technology developed by the Institute for Feed and Agriculture Podillya of National Academy of Agricultural Sciences.

During the vegetation there were made phenological observations, biometric measurements and yield counting with the help of conventional methods (Babich 1994) (Dospehov 1978).

According to science-based and methodical recommendations, the optimal stand density of alfalfa for forage depending on climate zones is as follows: in Polissya - 220-250, in Forest-Steppe – 180-220, and in Steppe zone – 150-180 plants per m^2.

Small-seeded crops, including alfalfa, have low field germination; considerable part of plants die in winter and during undercover period. Therefore, to determine seeding rates it should be taken into account the indices of field germination and thinning during the undercover period (Butenko 2011).

Research results. The peculiarity of perennial legume seed preparation for sowing, including alfalfa, is the presence of the seed shell that does not let water and air. Such seeds are called hard. Their number varies depending on the type, variety, weather conditions and so on. If seeds contain more than 20% of hard seeds, they have to be wounded mechanically or electrohidraulically with simultaneous treatment with minerals. Then they are inoculated with special legume bacterium strains and airborne thermal heating of seeds is provided [2].

Such seed preparation for sowing, firstly, increases, due to electrohidraulic wounding and seed processing with minerals, germinating energy by 20-30% and viability – by 5-10%; secondly, contributes to obtaining early and good sprouts; thirdly, improves yield by 10-12% and reduces costs per product unit. Due to inoculation, the total nitrogen content increases by 5% and harvest increase of hay yield is 9-10%. Wounding is done on special machines on term 10-12 days before planting or immediately before sowing.

Seeds are been dressed before sowing. In the farms or in areas where alfalfa is grown for the first time, it is necessary to treat seeds with alfalfa nitragin (rizotorfin). This is provided on the day of sowing in a shaded area. As a result of inoculation the productivity increases by 20 - 30%.

Seeds are been aerated and enriched with minerals (molybdenum, boron, manganese) before sowing.

Alfalfa is sown in early spring time along with early sowing of spring crops or with nurse crops at undersowing.

They are possible open spring and summer alfalfa sowings. The best term of summer sowing in Forest-Steppe zone falls at the period from June 20^{th} – July 20^{th}. The basic requirement for this is sufficient soil moisture.

For alfalfa sowing it is used combined grain-grass seeder Klen-1,2 and others. Sowing takes place in early spring using regular method in drills.

Alfalfa is sown using seeds of recognized varieties of not less than the second class clean of weeds, especially quarantine ones.

Different environmental conditions of growth and development of alfalfa in the first year, depending on the method of seeding, require determination of optimum seed rates to ensure the creation of high-productive stand in subsequent vegetation years. Biological feature of alfalfa is the ability of one plant to form a shrub with number of stems as many as 300, depending on the area of nutrition. Summarizing research results, we can conclude about practicability of plant density in the first year in Forest-Steppe zone to the tune of 200 pieces/m^2 providing stand density to the tune of 450 - 500 pieces/m^2.

Research has shown that the formation of the optimum stand density and of alfalfa leaf and stem mass yield are effected by seeding rate, sowing methods, the quality of soil preparation, seeding depth, moisture supply and varietal identity. Therefore, recommendations for standards of alfalfa seeding for feed are ambiguous and need clarification due to environmental conditions, especially taking into account the deficiency and high cost of the seed.

On the basis of obtained data that characterize the average agri-environmental conditions of growth and development of alfalfa, it should be mentioned that increase of seed rate causes the increase of field germination rate. However, at high density of alfalfa in the first year it takes place more intense process of thinning of stand in subsequent years.

It is found that the density of alfalfa sprouts depends on the type of companion crop and norm of its seeding. Significantly lower field germination of alfalfa is in terms of undersowing and combined sowing with barley, when compared with spring ruttishness and late spring crops, and especially with open sowing.

The optimum alfalfa seeding rate for getting the maximum nutrients in the first year is 6 - 8 million/ha of similar seeds.

In the second year of alfalfa living, open sowing provides much higher yield in all sowing norms. A common pattern is to increase crop growth at low seeding rates.

Thus, the optimum seeding rate for alfalfa in terms of open sowing should be considered 6-8 million/ha of similar seeds, which provides the density of plants in the first year at a rate of 250 - 300 pieces/m^2, in the second year - 200 – 330 pieces/m^2 and in the third year – 160 - 170 pieces/m^2 (Table).

Effect of seed rates on the productivity of medic sown in open method, t/ha

(average in 2007-2009)

Sowing rates mln/ha, piece	Open sowing			
	the second year		the third year	
	leaf and stem mass	dry matter	leaf and stem mass	dry matter
6	40.0	8.64	41.3	9.21
8	42.6	9.72	45.9	9.98
10	42.0	9.08	48.7	10.79

Study of alfalfa seed rates 6, 8 and 10 million / ha of seeds in terms of open and combined sowing with late spring crops showed that the maximum yield of dry matter for two years of stand use provided seeding with seeding rate equaled to 8,000,000 mln/ha of seeds.

So, in early spring sowing the maximum yield of alfalfa in terms of two-year use of stand is formed in open sowing with seed rate of 6 - 8 million/ha of similar seeds, while in undersowing with early spring crops – 10 - 12 million/ha of seeds. However undersowing crops with increased rate of seed yield provide less yield of leaf and stem mass, dry matter and crude protein.

Combined alfalfa seeding at a rate of 8 million/ha of seeds with early grains at a rate of 1.0 - 2.0 million/ha of seeds, provides almost the same productivity as open sowing.

In terms of late sowing, open and combined cultivation of alfalfa with maize for green fodder, the maximum yield is formed at a rate of 8 million mln/ha of seeds.

Conclusions

In terms of any kind of sowing, it should be created the stand the density of which in the first year of use was 200 plants/m^2 in the Forest-Steppe zone. For this end it should be reminded that small-seeded crops, including alfalfa, have low field germination, many of the plants die in winter and in undercover period. Thus, to determine the seeding rate it should be taken into consideration indicators of field germination and thinning in undercover period. That is, in order to obtain 200 plants/m^2 it should be sown under barley and maize 15 – 16 kg/ha and 14 kg/ha of alfalfa seeds respectively.

Seeding rate in terms of open sowing and high quality of preparation of seeds and soil is within 10-12 kg/ha.

In the Right-Bank Forest-Steppe zone of Ukraine the optimum seeding rate of alfalfa is 8 - 10 million of similar seeds per 1 ha, or 16 - 20 kg/ha at 100% economic feasibility. Sowing alfalfa under cover, the seeding rate is reduced by 20%: early spring cover crops are sown with seeding rate (million/ha of similar seeds): barley, oats - 2.0, maize for green fodder - 0.15 - 0.25 , Sudan grass - 1.0 million/ha of seeds.

In terms of pure spring sowing, agrophytocenoses of alfalfa field of the first year are unstable ecosystems with low competitiveness against weeds, requiring constant monitoring and regulation of their relations by means of farming techniques used for weed destruction.

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ПРОДУКТИВНІСТЬ ЛЮЦЕРНИ ЗАЛЕЖНО ВІД НОРМИ ВИСІВУ В УМОВАХ ПРАВОБЕРЕЖНОГО ЛІСОСТЕПУ УКРАЇНИ

В. Коваленко

Анотація*. Досліджено продуктивность люцерни, визначено процедуру підготовки насіння до сівби, строки і способи останньої залежно від різних норм висіву у Правобережному Лісостепу України. Встановлено, що формування оптимальної густоти і виходу маси листя і стебел люцерни залежить від норми висіву, способу сівби, якості підготовки ґрунту, глибини посіву, вологості, а також обраного сорту.*

Ключові слова: *люцерна, підготовка насіння, строки сівби, методи сівби, маса листя і стебел, суха речовина*

ПРОДУКТИВНОСТЬ ЛЮЦЕРНЫ В ЗАВИСИМОСТИ ОТ НОРМЫ ВЫСЕВА В УСЛОВИЯХ ПРАВОБЕРЕЖНОЙ ЛЕСОСТЕПИ УКРАИНЫ

В. Коваленко

Аннотация. *Исследовано продуктивность люцерны, определено процедуру подготовки семян для посадки, сроки и способы посева в зависимости от различных норм высева в Правобережной Лесостепи Украины. Установлено, что формирование оптимальной густоты и выхода массы листьев и стеблей люцерны зависит от нормы высева, метода посева, качества подготовки почвы, глубины посева, влажности, а также выбранного сорта.*

Ключевые слова: *люцерна, подготовка семян, сроки посева, способы посева, масса листьев и стеблей, сухое вещество*