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Productivity of Galega (*Galega orientalis*) in Single-Species and Binary Crops with Sainfoin (*Onobrychis arenaria*): A Case Study of Forest-Steppe of European Russia

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ABSTRACT

The results of field experiments on the cultivation of Eastern galega (*Galega orientalis Lam.*) in pure form and in binary sowings together with Hungarian sainfoin (*Onobrychis arenaria* (Kit.) DC) on eroded black soils of the south of European Russia were given. It is established that the culture of *O. arenaria* does not cause great suppression of *G. orientalis*. By year 4 of cultivation the aboveground dry phytomass of *G. orientalis* was 1012.3±58.1 g m-2 in binary sowings and did not differ significantly (at P=0.95) from phytomass in single-crop sowings (1078.5±114.0 g m-2). The phytocenosis of binary sowing of G. orientalis and O. arenaria has formed a more stable and productive phytocenosis for 2 cuts in total as compared to single-crop sowings, its component crops. On average for 2012-2015 a binary sowing of *G. orientalis + O. arenaria* had productivity of dry substance of aboveground phytomass of 1270.4 g m-2 (V=9.4%), a single-crop sowing of *G. orientalis* was 985.4 g m-2 (V=17.0%), and a single-crop sowing of *O. arenaria* 1121.0 g m-2 (V=21.7%). Binary sowings form aboveground phytomass in the first 2 years of the use by means of *O. arenaria*. At this time, its share in the phytocenosis is about 80.0%. Starting from the third year of life, the above-ground phytomass of phytocenosis is formed by *G. orientalis* whose share increases to 60.3% and reaches more than 80% by year 4 of the use (fifth year of life). It is noted that the weeds are most developed in single-crop sowings of *G. orientalis* during in the first 2 years of grass stands use. At this time, a share of weeds reaches 79.2-59.9% in the phytocenosis. Binary sowings are clogged much less. A share of weeds in the phytocenosis is within the range of 4.2-9.3% during the entire period of studies. It has been concluded that there is a need to cultivate *G. orientalis* in binary sowings together with Hungarian sainfoin in order to have success in the development of highly productive grass stands of this agricultural crop on the eroded black soils in the southern part of the European Russia.

KEY WORDS: *GALEGA ORIENTALIS*, *ONOBRYCHIS ARENARIA*, SLOPE ECOSYSTEMS, BINARY CROPS, OVER GROUND PHYTOMASS, PRODUCTIVITY, WEEDINESS CROPS.

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INTRODUCTION

From ecological considerations, it is necessary to expand the species composition of cultivated legumes, including non-traditional culture for many regions of the world of *G. orientalis* (Adamovich, 2001; Baležentiene et al., 2011; Guo et al., 2013; Bushuyeva, 2014a). The culture of *G. orientalis* is of great scientific and practical interest. The main advantages of this crop are high longevity and productivity and high feed properties (Saloniemi and Kallela, 1993; Faireych et al., 2000; Skorko-Sajko et al., 2005; Wang et al., 2012; Bushuyeva, 2014b; Rymuza, 2017). In regions with developed animal husbandry under changing climatic conditions, it is necessary to adjust and revise the species composition of perennial grass sowings in order to stabilize grass cultivation productivity and to create uninterrupted green and raw material conveyor (Dumacheva et al., 2018; Cherniavskih et al., 2019 a,b). In addition, it is a honey plant. However, a deficiency of *G. orientalis* is also found, which is its slow development in the first years of life.

The sowings do not have required projective cover; therefore, there are conditions for the introduction of weed species, which reduces the quality of feed and its profitability (Bardule et al., 2013; Meripõld et al., 2017). One of the ways to overcome this disadvantage is to use common sowings of *G. orientalis* jointly with cereals and legumes (Bekuzarova et al., 2013; Rancane et al., 2014).There are studies conducted in relation to common sowings of *G. orientalis* together with timothy grass (*Phleum pratense L.*), smooth brome (*Bromopsis inermis Holub.*), meadow fescue (*Festuca pratensis Huds.*), reed fescue (*Festuca arundinacea Schreb.*) and cocksfoot grass (*Dactylis glomerata L.*). There is data available on the cultivation of it as part of a mixture with the following legumes: alfalfa *(Mediago)* and clover *(Trifolium)* are reflected in a number of publications (Bull et al., 2011; Povilaitis et al., 2016; Meripõld et al., 2017).

However, most studies are conducted in regions with sufficient rainfall, where there are favourable conditions for the development of grasses. There it is expedient to use cereal-legume mixtures with *G. orientalis*.The conditions of the south of the Central Russian Upland are characterized by unstable humidification, and with close occurrence of Cretaceous rocks (in stony and rocky substratum), plant communities are formed in association with xerophytic plants of stressed conditions (Arora and Meena, 2016). Varieties of perennial grasses are poorer under such conditions; cereal grasses do not have high productivity and suffer from droughts. At the end of the 20th and beginning of the 21st centuries, a slight negative trend in precipitation changes is noted in the region (Novikova et al., 2017). The modern regional climate system is characterized by considerable variability in annual precipitation (V=21%), which fits into the rhythmic of 11-year cycles, which is determined by helio-climatic relations (Ivanov and Lisetskii, 1995). Climatic rhythm is refracted in the specifics of vegetation periods and forms the features of interannual variation in plant productivity (Lisetskii, 2007). Over the past 15 years, the overage rainfall factor was 0.87-0.94, which made it possible to regard the climatic situation as slightly arid.However, on eroded slopes, especially in the south-facing part, the deficiency of soil moisture is as a rule clearly manifested when compared with smooth lands, (Lebedeva et al., 2019).

As a forage and nectariferous crop the sainfoin is widespread in culture, especially on eroded slopes. Slopes with inclines of more than 5o occupy 8% of the area of the Central Chernozem region, a significant part of which is occupied by the Central Russian Upland. However, the Belgorod region has a more intense relief because slopes with 5 degrees or more cover 13.4% of the territory with soil cover erosion being about 60%. Agrogenic transformation of soils with the active development of erosion significantly changes the soil climate (Lisetskii, 2008). A significant proportion of slope soils occupied by pastures are heavily eroded due to previous use in ploughing. Therefore, post-agrogenic long-term fallow land has its own specifics both in the manifestation of autogenic succession (Lisetskii, 1998), and in soil evolution (Lisetskii et al., 2013), which distinguishes them from virgin slope soils.In the conditions of development of ecological agriculture for the breeding of large and small cattle (especially in goat husbandry) sainfoin has been again gaining importance in the modern world as a forage crop (James and PittsSinger, 2008; Dzyubenko and Abdushaeva, 2012; Vazhov et al., 2013; Dzyubenko, 2015).

There are no studies in joint sainfoin and galega sowings described in the literature, although it is of significant scientific and practical interest for several reasons:increased productive longevity of grass stands due to *G. orientalis* culture;possible high productivity per 1 year of grass stands use due to sainfoin culture;nearly the same quality of herbage (both cultures cause no distention in animals, are well eaten by the same species of animals, and being high-protein crops have roughly the same stem coarseness);simultaneous onset of mowing ripeness.However, it remains unclear whether it is possible to cultivate and to grow them jointly. The aim of the present studies is to look into formation dynamics of aboveground phytomass of Eastern galega in binary sowing with Hungarian sainfoin in comparison with pure sowings of these crops and to assess the potential productivity of these agrophytocenoses in the eroded black soils of southern part of Russia. The objectives of the study included an assessment of accumulation dynamics of aboveground phytomass dry substance, weed infestation of crops and evaluation of productivity of agrophytocenoses in general.

MATERIALS AND METHODS

Study area: South-western slope of the Central Russian Upland, which occupies about 14% of the area of the European part of Russia. The research was carried out in the Belgorod region, in the Krasnoyruzhsky district (47920 ha). The climatic conditions of the study area are characterized by the following indicators: sunshine duration – about 1800 hours, total solar radiation reaches about 4000 MJ m-2, the average annual air temperature is 5.8 °C (in summer 18.4 °C, in winter -6.5 °C), frost-free period on average 157 days. The average annual rainfall is 560 mm, summer humidity averages 70%.

Weather conditions during the years of research (2012-2015) were at the level of long-term average.The studies were carried out as a stationary field experiment. Slope northeast exposure, slope 5-7°. The soil is typical moderately eroded black soil. Humus content – 3.9 %, P_2O_5 – 108 mg kg^{-1} (by Chirikov), K_2O – 106 mg kg^{-1} (by Chirikov), the content of easily hydrolyzable nitrogen before laying experience 140 mg kg^{-1}, pH HCl 6.0. The experiment investigated Eastern galega *(Galega orientalis Lam.),* Gale variety, and Hungarian sainfoin *(Onobrychis arenaria (Kit.)* DC), Zernogradskiy grade.

Experiment options

1. Pure sowing of sainfoin (sowing rate of 5 million germinating seeds per 1 ha).
2. Pure sowing of galega (sowing rate of 2 million germinating seeds per 1 ha).
3. Binary sowing sainfoin and galega (sowing rate of sainfoin 5 million viable seeds per 1 ha, galega – 2 million germinating seeds per 1 ha).

The method of experiment establishment – organized replications. Total plot area 12 m2. The replication is sixfold. The crops were sown in spring 2011 under the cover of mustard seeds (mustard sowing rate of 6 kg per 1 ha). The planting method - line one with 25 cm inter-row spacing. A combined seeding of galega and sainfoin was carried out crosswise at an angle of 15 cm. Mixed samples for soil analyses were taken by a sampler at 10 places (0-10 cm) on the plot and then prepared a combined sample. Mixed samples were prepared from each of the six plots. The soil was brought to air-dried condition, ground down and analysed. The biological repetition for all indicators is 2-fold and the total one is 12-fold.The productivity of aboveground phytomass (in a green form) was determined by mowing method 2 times a season during the budding phase. Land plot 4 m2. The replication is 6-fold.The proportion of each component and weed vegetation was determined using the method of sheaf analysis. Cut off the aerial mass from an area of 1 m2 and separately weighed the stems of crops and weeds. To determine the content of absolutely dry substance a 1.5-2 kg sample was taken from the total mass and then brought to air-dried condition in gauze bags. The air-dry mass was completely crushed to powder in the mill. From the mass obtained, 50-60 g samples were taken out on a four-time repeated basis and dried completely in a thermostat at a temperature of 105-106 °C within 8 hours.

The dry matter content (percentage) was calculated for each repetition and the average value was determined. The results were statistically processed using single-factor and two-factor analysis-of-variance methods for field experiments (Dospekhov, 1985; Lakin, 1990). We determined the reliability of differences, the least significant difference and the share of influence by the studied factors on the resultant feature. To estimate how close the relations were a pair correlation coefficient was used.

RESULTS AND DISCUSSION

The theoretical basics of the formation process of the combined crops productivity in comparison with single-crop sowings were justified by the H.G. Tooming works (1972, 1984). The principles of time sequence of growth, component development and maximum use of photosynthetically active radiation (PAR) make the basis for sustainable growth and development of combined plantings. Consistent co-growth and stability of phytocenosis can be achieved subject to concurrent fulfilment of two conditions. Firstly, phytocenosis should consist of species, which have different specific radiation intensity (SRI) (SRI means flux density PAR to achieve maximum gas exchange efficiency factor (CP)). Secondly, the maximum efficiency factors of these species should be close (Tooming, 1984).Thus, to ensure a high degree of use of solar radiation by the entire planting, the crops, which have been included in the grass mixture with similar biological and abiotic planting factors, should be different in SRI and have very close efficiency factors (Tooming, 1984).

As regard, our experience of *G. orientalis* Hungarian sainfoin can be the most complementary related culture in grass mixtures. This conclusion is based on four arguments. First, the architectonics of sainfoin leaves provides for significant penetration of photosynthetic active radiation deep into the grass stand, which can greatly reduce competition for the light. Secondly, sainfoin generates up to 80% of its first mowing yield. This makes lighted any crop planted in the second half of the summer, which practically excludes competition for the light. Thirdly, sainfoin has a tap-root system, which is located in deeper soil horizons as compared to G. orientalis's sprouted surface root system, which can diminish competition for nutrients and root secretions allelopathy. Fourthly, sainfoin can form primary above-ground phytomass in 1 to 2 years of the use of grass stands. In subsequent years, it can dramatically decrease of productivity, which significantly reduces its competitiveness.

Architectonics and structure of the *G. orientalis* bush can be considered ideal from the point of view of the rational use of photosynthetic active radiation since the upper leaves of the plant are almost vertical and they gradually move to a horizontal position at the bottom of the stem (Tammers, 1970). Sainfoin plants have similar leaf arrangement. Thus, one can be assume that these two species will minimally compete for the light, and due to this, the intensity of the main form of competition for photosynthetic active radiation will be lower for mixed sowing.The result should be ended in phytocenosis with sainfoin being dominated at stage 1 and without strong suppression of galega. By the time when less longeval sainfoin plant has fallen out of grass stand, the galega will have already reached its maximum development and further form its own multi-year grass stand.

The key efficiency indicator for the use of the environment by plants is their ability to form phytomass. The higher competition the species face from their neighbours, the lower their ability to accumulate the above-ground phyto mass. The research results have shown that in single-crop sowings with significant level of probability being equal to P=0.95 in the first 3 years of vegetation the G. orientalis plants exceeded in terms of above-ground phytomass amount the first mowing of plants grown in a mixture with Hungarian sainfoin. By year, four of the use of grass stands the differences used to become unreliable. In the second mowing significant differences in the productivity of galega in pure form and in a mixture with sainfoin were established at the probability level of P=0.95 for years 2 and 3 of the use of grass stands. No differences were found by the fourth year of use (Table 1).

Table 1: Accumulation of aerial phytomass of *G. orientalis* culture in single-species and binary crops with two mowing of grass stands, g m^{-2} (absolutely dry matter)

Mowing	Sowing Method	Year of research				
		2012	2013	2014	2015	2012-2015
First	single-species	145.0	235.8	512.5	639.0	383.1
	binary	124.6	193.1	402.9	609.7	332.6
	average	134.8*	214.4*	457.7*	624.4	357.8*
	LSD_{05}	15.4	24.8	41.7	42.6	38.6
Second	single-species	27.8	90.2	313.5	439.5	217.8
	binary	24.7	74.9	260.4	402.6	190.6
	average	26.3	82.6*	287.0*	421.1	204.2*
	LSD_{05}	4.4	11.4	33.6	55.2	26.2
Just two	single-species	172.8	326.0	826.0	1078.5	600.8
mowing	binary	149.3	268.0	663.3	1012.3	523.2
	average	161.1*	297.0*	744.7*	1045.4	562.0*
	LSD_{05}	6.9	23.8	47.3	86.0	41.0

Note: * differences between single-species and binary crops are significant at P=0.95.

In general, a similar tendency was noted for two mowing. The reliability of differences at the level of P=0.95 was ascertained in the course of the first 3 years of research. By year 4 of life, the differences were bridged.The productivity of the second mowing of *G. orientalis*, when cultivated in pure form, was 19.1% of the value of the first mowing in 2012 and 68% in 2015. When cultivated in binary sowing, its value was 19% in 2012 and 66.0% in 2015 respectively. The reverse trend was observed for sainfoin sowings. The largest aboveground phytomass was formed in the first 2 years of grass strand use with a sharp decrease by year 3 and 4 of life. The sainfoin plants had much higher decreased in their productivity for binary sowings in competition with to galega. Except for the first mowing of year 1 of life (2012), in all other cases a significant decrease in the productivity of this crop was established for binary sowings at the level of P=0.95 as compared with single-crop planting (Table 2).

Table 2. Accumulation of aerial phytomass of *O. arenaria* culture in single-species and binary crops with two mowing of grass stands, g m^{-2} (absolutely dry matter)

Mowing	Sowing Method	Year of research				
		2012	2013	2014	2015	2012-2015
First	single-species	750.6	818.3	349.3	293.5	552.9
	binary	711.4	650.8	220.7	130.4	428.3
	average	731.0	734.6*	285.0*	212.0*	490.6*
	LSD_{05}	41.8	38.9	29.8	15.1	30.2
Second	single-species	467.9	527.7	145.0	112.8	313.4
	binary	382.6	430.0	113.8	48.1	243.6
	average	425.3*	478.9*	129.4*	80.5*	278.5*
	LSD_{05}	40.9	32.2	23.4	19.5	29.1
Just two	single-species	1218.5	1346.0	494.3	406.3	866.3
mowing	binary	1094.0	1080.8	334.5	178.5	671.9
	average	1156.3*	1213.4*	414.4*	292.4*	769.1*
	LSD_{05}	49.1	37.8	27.1	27.2	35.2

Note: * differences between single-species and binary crops are significant at P=0.95.

Table 3. The share of the influence of the studied factors on the total variability of the productive trait "magnitude of the aboveground phytomass" of *G. orientalis* and *O. arenaria* when cultivated in clean and binary crops (for a total of two mowings), %

Source of variation	2012	Years of research		
		2013	2014	2015
Reiteration	0.48	0.42	5.21	2.13
Random errors	0.35	0.08	1.28	0.99
Options, including	99.17*	99.50*	93.51*	96.88*
Factor A – "Crop"	98.90*	95.33*	78.40*	92.30*
Factor B – "method of sowing"	0.25	2.96	14.10*	3.52
Factor AB – Interaction	0.02	1.21	1.01	1.06

Note: * differences are significant at P=0.95.

To study the extent of influence of such key organized factors as A – “crop” *(G. orientalis* and *O. arenaria)*, B – “method of sowing” (single-crop and binary) and the “yearly conditions” factor in the total variation of resultant variable “overground phytomass size” we used practical two-way analysis of variance. An analysis of the data obtained over 4 years of research showed that the share of influence by the studied factors in the total variability is from 89.2% in 2014, up to 99.2% in 2012. The share of influence in the total variability for the resultant variable “aboveground phytomass size” was equal to 78.4% in 2014, up to 98.9 in 2012 for two mowing by the key factor A – “crop”, and it has always been reliable at the level of P=0.95. The share of influence by the factor B – “method of sowing” varied from 0.25% in 2012, up to 14.1% in 2014, and it has not been always reliable at the level of P=0.95. The share of influence by interrelated factors AB is unreliable (Table 3).

The Table 3 shows that the year of 2014 is noted for significant share of influence by factor B – “method of sowing”. This is year 3 of grass stands use when the maximum level of mutual competition among sainfoin, galega and weeds was observed. At that, time the sainfoin crop already started to fall out of the grass stand and the galega crop did not have sufficient mass yet. There was competition emerged both inter-crops and between the weeds and the crop.An analysis of the share of influence by the studied factors in the total variability of the resultant variable “aboveground phytomass size” (by 2014) has showed that in the first mowing the studied factors made 89.25%, and the share of repetitions was 10.36%. In the total variance of variants the share of the studied factor A “crop” was reliably (at the level of P=0.95) equal to 60.36%, and the share of the factor B – “method of sowing” was 28.7%. The share of interaction was negligible. This goes to prove that to the first cut 3 years of life the processes of the most intense competition in the genotype-environment system occurred when the influence of the environment became significantly high. y the second mowing, the process was stabilized.

The share of influence by the factor decreased to 5.87% and the factor’s A share increased up to 82.3%. Subsequently, the galega crop finally began to dominate in joint sowings and dynamically increased its vegetative mass.An analysis of the total vegetative mass of phytocenoses showed that the binary sowing formed a more stable phytocenosis over two mowing in total as compared to single-crop sowings. In the first 2 years of the use of grass stands a single-crop sowing of *O. arenaria* and a binary sowing of *G. orientalis + O. arenaria* significantly exceeded a single-crop sowing of *G. orientalis* at 456.9-620.4 g m-2 in terms of above-ground phytomass, thus not differing significantly from each other by this indicator (Table 4).

The galega sowings and a binary planting under the conditions of year 3 and 4 of the use significantly exceeded the Hungaring sainfoin sowings in terms amount of dry substance of above-ground phytomass. The coefficient of variation of above-ground phytomass of binary phytocenosis of *G. orientalis + O. arenaria* was 9.4% on the average for the research years and that of pure *G. orientalis* – 17.0%, and *O. arenaria* – 21.7%. Over an average of 4 years of studies that monospecific sainfoin sowings and binary plantings are significantly superior to the single-crop sowing of *G. orientalis* by above-ground phytomass size. The amount of aboveground phytomass of monospecific galega sowing and its binary planting together with sainfoin by year 4 of the use did not differ significantly.The share of the main phytocenosis components in the total phytocenosis productivity was analysed (Table 5). In general, based on the experience available it has been found that the share of Galega tends to increase in grass stands and its sowings, both single-crop and binary ones tend to be less infested as the grass stand becomes older.There was a tendency found towards decreased productivity of sainfoin and its share in the phytocenosis as the grass stand became older and towards increased sainfoin infestation.

Table 4: Accumulation of aboveground phytomass by *G. orientalis* and *O. arenaria* phytocenoses in (taking into account weed vegetation) in single-species and binary crops with two mowing of grass stands, g m^{-2} (absolutely dry matter)

Crops	Years of research				
	2012	2013	2014	2015	2012-2015
G. orientalis	832.2*	812.5*	1092.1	1204.6	985.4*
O. arenaria	1289.1	1428.7	863.7*	902.5*	1121.0*
G. orientalis + O. arenaria	1305.6	1432.9	1099.8	1243.1	1270.4
LSD_{05}	38.7	21.5	38.1	49.3	38.6

Note: * differences are significant at P=0.95.

During the entire research period the binary sowings of *G. orientalis* and *O. arenaria* were significantly infested to a lower extent as compared to the pure sowings of G. orientalis at the level of P=0.95. In the first 2 years single-crop sowings of sainfoin did not differ significantly by the level of infestation from binary plantings (P=0.95). Starting from year 3 of life the sowings became more infested as the main crop was gradually failed and the proportion of weeds reached 42.8-55.0%.

We have established that any mixed sowing consistently tends to have a reduced share of sainfoin in the aboveground phytomass from 83.8 to 14.4% and an increased share of galega from 11.4 to 81.4% over 4 years of joint cultivation against the background of a stable proportion of weeds being at the level of 4.2-9.3%. One can observe an actual succession change of plant community dominant when one legume crop gradually replaces another, and the share of the legume component (cultural component of the community) remains stable at 90.7-95% (V=2.1%).

Table 5. Percentage of participation of various components in the phytomass structure of phytocenoses of single-species and binary crops of *G. orientalis* and *O. arenaria* (an average of two mowing), %

Crops	Phytocenosis components	Years of research				
		2012	2013	2014	2015	2012-2015
G. orientalis	crop	20.8*	40.1*	75.6	89.5	56.5
	weeds	79.2*	59.9*	24.4	10.5	43.5
O. arenaria	crop	94.5	94.2	57.2*	45.0*	72.7
	weeds	5.5	5.8	42.8*	55.0*	27.3
G. orientalis + *O. arenaria*	crop of everything, including:	95.2	94.1	90.7	94.8	94.0
	G. orientalis	11.4	18.7	60.3*	81.4*	43.0
	O. arenaria	83.8*	75.4*	30.4	14.4	51.0
	weeds	4.8	5.9	9.3	4.2	6.0
LSD_{05}	crop	2.2	3.0	3.6	3.1	3.0
	G. orientalis	1.2	1.4	1.8	3.0	1.9
	O. arenaria	2.2	3.8	2.4	1.8	2.5
	weeds	1.3	1.3	1.9	1.7	1.6

Note: * differences are significant at P=0.95.

The coefficient of variation of the cultural component in the single species crops of *G. orientalis* and *O. arenaria* was higher, 61.0% and 48.4%, respectively. In general, based on the experiment available we have found a weak negative correlation between the value of absolutely dry substance in *G. orientalis* phytomass and the value of absolutely dry substance in *O. arenaria* phytomass as regards binary sowings (r= – 0.318±0.128), there is also moderate negative correlation between the value of *G. orientalis* phytomass and the value of phytomass of weeds' absolutely dry substance in plantings (r= – 0.534±0.130).

CONCLUSION

To create of sustainable high-yielding grass stands with *G. orientalis* in the south of European Russia it is necessary to have its binary sowings with *O. arenaria*. In joint sowings, the *O. arenaria* crop causes no strong suppression of *G. orientalis*. In binary sowings, the productivity of *G. orientalis* above-ground phytomass has weak dependence on the value of *O. arenaria* aboveground phytomass, which results in favourable conditions for their joint growth in grass mixtures. When being used on a double-cutting basis the binary sowings of *G. orientalis* and *O. arenaria*, tend to form more productive and stable phytocenosis as compared to single-crop plantings. Binary sowings can ensure stable generation of above-ground phytomass in the first two years of the use by means of O. arenaria. During this period, it is part of the cultural part of 83.0% phytocenosis. Starting from year 3 of life the above-ground phytomass of phytocenosis is formed by *G. orientalis* whose share increases up to 60.3% and reaches > 80% by year 4 of the use (fifth year of life). It is noted that the weeds are most developed in single-crop sowings of *G. orientalis* during in the first 2 years of grass stands use. At this time, a share of weeds reaches 79.2-59.9% in the phytocenosis. Binary sowings are clogged much less. A share of weeds in the phytocenosis is within the range of 4.2-9.3% during the entire period of studies. In single-crop, sowings of *O. arenaria* weeds have been noted to spread most widely in year 3 to 4 of the use of grass stands and is 42.8-55.0%.

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