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Formation of vegetative mass by white sweerclover (*Melilotus albus* Med.) annual plants

Raisa Vozhehova, Anatoly Vlashchuk, Olesia Drobit, Oksana Vlashchuk, Tetiana Marchenko, Vira Borovyk, Nataliia Valentiuk*, Oleksandr Shablia and Hennadii Ivanov

Institute of Climate Smart Agriculture of the NAAS, sett. Khlybodarske, Odesa District 67667, Ukraine
**Corresponding author:* naval100@ukr.net

Abstract

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The results of research on the growth of the above-ground mass of plants, as well as the formation of the yield of conditioned seeds of the annual white sweetclover depending on the variety composition, the width of the rows and nitrogen nutrition, are presented. It was determined that the smallest amount of raw above-ground mass of white sweetclover was formed when sowing with a row width of 60 cm. The most favorable conditions for the formation of above-ground dry mass of white sweetclover are created in the Pivdennyy variety when applying a dose of N_{60} and a row width of 45 cm. The highest yield of conditioned seeds of annual white sweetclover (495 kg/ha) and the maximum yield of conditioned seeds from a unit of area (89.0%) was provided by the cultivation of the Pivdennyy variety with a row width of 45 cm and nitrogen fertilization with a dose of N_{60}. The modification variability (Vm, %) depending on the application of doses of nitrogen fertilizer and amounted to 2.65–9.26% for the Pivdennyy variety and 2.71–9.38% for the Donets′kyy annual variety.

Keywords: variety; row width; dose of nitrogen fertilizer; wet and dry above-ground mass of plants; yield

Introduction

In the current economic conditions, it is possible to solve the problem of vegetable protein by increasing the sown areas, expanding the assortment and increasing the yield of perennial and annual fodder leguminous crops. It also contributes to the natural restoration of soil fertility thanks to the nitrogen-fixing ability of plants, which is especially relevant today due to the increase in the cost of mineral and organic fertilizers (Vozhehova et al., 2020; Rigal & Rigal, 2016; Demydas' & Zakhlebaev, 2017; Harker et al., 2012; Babich & Poberezhna, 2000).

The south of Ukraine belongs to the zone of risky agriculture, therefore, growing drought-resistant agricultural crops, that are able to form stable yields of high-quality seeds in extreme conditions in the region is of exceptional importance (Bezuhlyy & Prysyazhnyuk, 2012; Tsandur, 2006; Zinchenko et al., 2003; Denisow & Malinowski, 2016).

These requirements are fully met by the white sweetclover – a universal legume crop characterized by high stable yield and drought resistance, heat resistance, relative undemanding to soils, high manufacturability, valuable phytomelioration properties, the ability to ensure the reclamation of lands that have undergone man-made stress, with a less costly biological method (Wolf, 2004; Vozhehova et al., 2020; Zinchenko et al., 2003).

Annual white sweetclover (*Melilotus albus* Med.) is a productive fodder crop that can contribute to increasing the economic efficiency of the fodder industry (Martin, 1934; Vlashchuk et al., 2015; Cornara, 2016).

For the widespread introduction of the culture into agricultural production, it is important to carry out selection work on the breeding of new varieties and to improve the cultivation technology in the areas of its use (Calvino et al., 2003; Halwankar et al., 1989). In particular, in the studies of Gibson & Gibson (1995) was found that elements of technology, such as sowing methods and mineral nutrition, require more detailed study. The positive effect of using mineral fertilizers has been established by many scientists (Nyfeler, 2009; Clayton et al., 2004; Meyer, 1984; Armin et al., 2011; Parrish, 2005; Özköse & Tamkoç, 2016). Due to the lack of information on this issue, research on the optimization of the technology of growing white annual sweetclover in the arid conditions of the southern zone of Ukraine is relevant.

The accumulation of above-ground biomass by plants significantly affects the productivity of crops (Antonova et al., 2019; Gibson & Gibson , 2006). The passage of this process is especially important in the southern region, where the death of the leaf apparatus is usually observed even before the seeding period (Vozhehova et al., 2020; Vlashchuk et al., 2015). The absolute values of the increase in above-ground mass are external indicators of the processes occurring inside the plant (Rajput et al., 2008; Tristram, 2013).

Therefore, monitoring the rate of growth of above-ground mass is particularly relevant, as it fully reflects the influence of one or another factor on the plant, the formation of the assimilation surface, and therefore the potential yield.

The aim of the work was to determine the processes of formation of the above-ground mass of white annual sweetclover plants depending on the parameters of the width of the rows and doses of nitrogen fertilizer in non-irrigated conditions of southern Ukraine.

Materials and Methods

We studied the response of annual white sweetclover varieties to different growing conditions, namely: sowing methods and nitrogen feeding options in the conditions of southern Ukraine. The research and experimental part was conducted in the conditions of the experimental field of the Institute of Irrigated Agriculture of the NAAS, located in the south of the Kherson region during 2018–2020.

The experiment was laid out by the method of split plots in four repetitions. Generally accepted methods of conducting a field experiment and methodical recommendations were used (Vozhehova et al., 2014; Ushkarenko et al., 2014). Research was carried out consistently, the obtained data was systematized. Factor A – varieties of white annual sweetclover Pivdennyy and Donetskyy annual, Factor B – width of rows (15–30–45–60 cm), Factor C – doses of nitrogen fertilizer (control – without fertilizers, N_{30}, N_{60}, N_{90}). Placement of variants is randomized. The area of the experiment is 1200 m^2, the area of one plot is 5 × 2.5 m^2. The experiment followed the principle of a single logical difference, as well as a range of gradations of factors, which allows determining the optimal parameters of the action of each of the factors. The results of crop accounting were processed by the methods of dispersion, correlation and regression analyzes using a personal computer and the “Agrostat” software and information complex.

The predecessor of the researched crop was winter wheat. After its collection, the post-harvest residues were peeled in two tracks. The main tillage, namely, deep plowing to a depth of 25–27 cm was carried out in November. In early spring, harrowing was carried. Before sowing, pre-sowing cultivation was carried out to a seed wrapping depth of 3–4 cm and nitrogen fertilizers – ammonium nitrate was applied manually, according to the experiment scheme.

Sowing was carried out annually in the first decade of April with a seeder according to the experiment scheme – ordinary row with a row width of 15 cm, and wide rows with a row width of 30, 45 and 60 cm. After the emergence of seedlings, the crops were chemically treated against weeds with the herbicide Pulsar 40 with calculation of 1 l/ha. In the first decade of September, the harvest of sweetclover seeds was carried out with a combine harvester (Sampo-130). Seeds were collected separately from each plot, at 12–13% moisture content of the seed crop. Immediately after collection, with the help of laboratory equipment, additional cleaning was carried out on an cleaning machine.

The soil of the experimental sites is dark chestnut medium loamy, weakly saline, the soil-forming rock of which is loess loam, enriched in lime and gypsum, and also has a fairly high density. It was distinguished by the homogeneity of the soil horizons, as well as the tendency to decrease clay particles in the humus layer and their gradual accumulation in the transition horizon, the pH of the water extract of the arable soil layer is 6.8–7.2. Groundwater lies at a depth of 18–20 m and practically does not affect the water-air regime of the zone of active moisture exchange. The hydro-physical and physical-chemical properties of the soil of the research area, in general, were typical for dark chestnut medium loamy soils of southern Ukraine.

The climate of the research area is of a continental type with an insufficient amount of atmospheric precipitation and its extremely uneven distribution throughout the year, low relative humidity, warm autumn and winter, as well as a long frost-free period. The region is also characterized by the greatest aridity and the greatest thermal resources, almost every year there are periods with strong winds, dust storms, and droughts, which cause great damage to agriculture (Babich & Poberezhna, 2000; Tsandur, 2006).

Thus, the soil and climatic conditions of the south of Ukraine are favorable for the formation of a high and stable yield of crop seeds, but due to insufficient rainfall with a significant influx of heat resources, the potential of the crop is not always able to be realized. In connection with this, it is necessary to constantly improve the elements of cultivation technology. Meteorological conditions during the years of research – temperature regime and amount of precipitation – were typical for the southern zone of Ukraine and favorable for the formation of sweetclover seeds. In particular, in 2018, the amount of precipitation during the vegetation period was 277.7 mm, in 2019 – 169.1 mm, in 2020 – 194.0 mm (Table 1). The average air temperature during the growing season in the research years varied little and amounted to 18.9°C in 2018, 19.4°C in 2019, and 20.8°C in 2020. It should be noted that in 2019, in the first half of the sweetclover growing season (March-May), there were favorable weather conditions for obtaining seedlings, growth and development of plants. In the second half of the growing season (June-August), as a result of rising temperatures and limited rainfall, hot and dry weather prevailed, especially at the end of the growing season.

In general, the weather and climate conditions of 2018–2020 fully reflect the agro-climatic resources of southern Ukraine. They were favorable for conducting research (obtaining friendly seedlings, full-fledged growth and development) and had a significant impact on the structural indicators and productivity of the white sweetclover.

Results and Discussion

One of the main conditions for the formation of high seed productivity of the white annual white sweetclover is the accumulation of above-ground mass by plants, already starting from the first phases of development. It is common knowledge that cultivated plants mobilize nutrients from the above-ground mass (Zinchenko et al., 2003; Rochon & Doyle, 2004). The researches of 2018–2020 established that the formation of the amount of raw mass of annual white sweetclover plants was influenced by the variety composition, the width of the rows and the dose of nitrogen fertilizer (Table 2). Varietal composition had a significant effect on the indicators of raw above-ground mass of crop plants – in all phases of growth it was the maximum in the Pivdennyy variety.

Thus, in the phase of branching according to the experimental variants, the value of the indicator, on average, fluctuated within the range of 321–892 g/m^2, which was 35–89 g/m^2 higher than the similar values of the indicator in the Donets′kyy annual variety.

In the subsequent phases of plant growth, a similar trend persisted.

The maximum amount of raw mass of the one-year sweetclover plant was formed in the flowering phase: in the Pivdennyy variety, the value of the indicator varied between 1002–2089 g/m^2, in the Donets′kyy annual variety – 970–1912 g/m^2. According to the obtained data, it was determined that the lowest amount of raw above-ground mass of sweetclover during the period of observations in all phases of growth was formed by sowing with a row width of 60 cm. In the branching phase against the background of unfertilized varieties, the annual value of the indicator was, respectively, 321 g/m^2 and 286 g/m^2. For other variants of the width of the row spacing, the raw mass increased slightly and varied between 353–470 g/m^2 in the variants with the Pivdennyy variety and 341–426 g/m^2 in the crops of the Donets′kyy annual variety. The application of nitrogen fertilizer had a peculiar effect on the dynamics of the formation of raw above-ground mass by sweetclover plants. The maximum values of the indicator in different phases of the development of crop varieties were obtained with the use of optimal fertilization – N_{60}. The maximum amount of raw above-ground mass of

Table 1. Meteorological conditions during the growing season by years of research (2018–2020)

Month	Average air temperature, °C			Relative air humidity			Amount of precipitation, mm		
	2018	2019	2020	2018	2019	2020	2018	2019	2020
April	12.6	9.3	14.1	71	72	58	56.8	87.9	1.6
May	16.2	16.3	19.5	76	64	59	71.7	25.6	35.7
June	22.1	22.0	22.9	69	61	51	43.0	10.3	23.1
July	24.4	23.4	24.2	58	60	61	46.3	39.8	90.8
August	24.7	25.4	25.5	59	51	46	26.7	4.8	0
September	13.3	19.9	18.7	63	61	64	33.2	0.7	42.8
Total	18.9	19.4	20.8	66.0	61.5	56.5	277.7	169.1	194.0

Source: Data of meteorological station

Table 2. The dynamics of the formation of raw above-ground mass by plants of one-year-old gorse, depending on the studied factors, g/m² (average for 2018–2020)

Factor B, row width, cm	Factor C, nitrogen fertilizer dose, kg/ha	Development phases					
		Pivdennyy variety			Donets′kyy annual variety		
		branching	budding	flowering	branching	budding	flowering
Raw above-ground mass							
15	No fertilizers (control)	353	575	1072	341	512	1063
	N_{30}	671	1053	1554	570	968	1409
	N_{60}	769	1248	1769	687	1131	1568
	N_{90}	612	974	1451	536	893	1205
30	No fertilizers (control)	398	609	1211	388	567	1129
	N_{30}	809	1127	1691	739	1088	1645
	N_{60}	892	1365	1926	803	1247	1761
	N_{90}	765	1048	1571	649	1139	1472
45	No fertilizers (control)	470	645	1287	426	608	1149
	N_{30}	879	1242	1837	789	1192	1814
	N_{60}	925	1527	2089	894	1368	1912
	N_{90}	791	1163	1625	710	1046	1508
60	No fertilizers (control)	321	543	1002	286	479	970
	N_{30}	604	962	1480	497	902	1339
	N_{60}	630	1175	1629	608	1024	1487
	N_{90}	545	891	1363	436	830	1182
Assessment of the significance of partial differences							
LSD_{05}, g	A = 2.7; B = 2.0; C = 3.1						

Source: Authors' concept of the experiments

annual white sweetclover was formed in the Pivdennyy variety against the background of application of N_{60} at a row width of 45 cm and, respectively, in the phases of branching, budding and flowering, it was 925, 1527 and 2089 g/m². The Donets′kyy annual variety had the highest values of the indicator of the formation of raw above-ground mass under similar parameters of agrotechnics (width between rows 45 cm and doses of nitrogen fertilizer N_{60}) – respectively, 894, 1368 and 1912 g/m².

An important aspect of the experiment is the possibility of determining the level of influence of raw above-ground mass on the formation of the yield of conditioned seeds of white sweetclover. It was established that there is a direct correlation between the accumulation of raw above-ground mass and the yield of conditioned seeds (Figure 1).

Thus, in the phase of physiological maturity, the correlation coefficient between the accumulation of raw above-ground mass and the yield of conditioned seeds is high and was 0.846. Investigating the correlation-regression model of the dependence of the yield of conditioned seeds and the accumulation of raw above-ground mass, we see that in order to increase the efficiency of seeding, it is necessary to

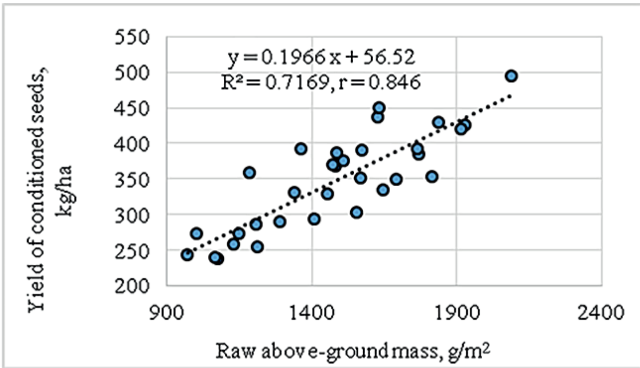

Fig. 1. Correlation-regression model of the dependence of yield of conditioned seeds and raw above-ground mass (average for 2018–2022)
Source: Authors' concept of the experiments

develop elements of technology that increase the yield of its conditioned seeds.

A similar dependence was observed in similar phases of culture development and in the accumulation of air-dry above-ground mass (Table 3).

Thus, during the flowering period, the white annual sweetclover plants accumulated the largest amount of air-dry above-ground mass, which ranged from 397.3 to 856.3 g/m^2 in the Pivdennyy variety and 392.1 to 787.9 g/m^2 in the Donets′kyy annual variety depending on the method of sowing.

According to the results of the conducted research, it can be stated that the most favorable conditions for the formation of above-ground mass of sweetclover are created in the Pivdennyy variety with a row width of 45 cm and the use of nitrogen fertilizer with a dose of N_{60}. It has been established that there is a close direct correlation between the accumulation of dry above-ground mass and the yield of conditioned seeds of annual sweetclover varieties (Figure 2). Thus, in the flowering phase, the correlation coefficient between the accumulation of dry above-ground mass and the yield of conditioned seeds was 0.84. According to the Chaddock scale, the qualitative measure of correlation is "high". The analysis of the obtained correlation-regression model allows us to draw a conclusion about the high positive influence of the indicator on the productivity of conditioned seeds, which must be taken into account in breeding and seed practice.

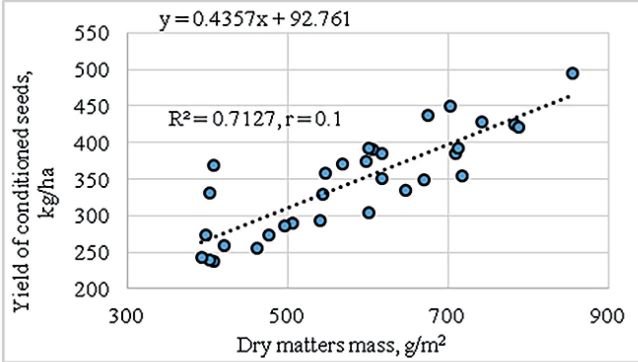

Fig. 2. Correlation-regression model of dependence of conditioned seed yield and dry matter mass (average for 2018–2020 pp.)

Source: Authors' concept of the experiments

Table 3. The raw above-ground mass of annual sweetclover plants, depending on the studied factors, g/m^2 (average for 2018-2020)

Factor B, row width, cm	Factor C, nitrogen fertilizer dose, kg/ha	Development phases					
		Pivdennyy variety			Donets′kyy annual variety		
		branching	budding	flowering	branching	budding	flowering
Raw above-ground mass							
15	No fertilizers (control)	96.2	178.2	407.5	94.7	165.1	402.3
	N_{30}	190.8	347.5	601.2	160.9	312.0	541.1
	N_{60}	234.6	422.3	708.9	207.1	386.5	617.4
	N_{90}	181.5	310.9	544.0	156.2	298.7	496.2
30	No fertilizers (control)	112.4	194.1	462.5	109.8	181.2	420.9
	N_{30}	235.7	378.4	670.8	210.9	372.0	647.8
	N_{60}	276.9	471.0	783.6	247.1	432.9	712.5
	N_{90}	231.2	349.3	605.7	197.8	341.5	569.0
45	No fertilizers (control)	121.8	211.5	506.2	125.3	197.1	476.7
	N_{30}	279.4	430.8	742.9	242.3	387.6	718.1
	N_{60}	296.7	512.3	856.3	278.5	473.1	787.9
	N_{90}	245.1	388.0	674.5	227.8	349.6	598.8
60	No fertilizers (control)	92.8	174.0	397.3	83.9	156.2	392.1
	N_{30}	95.6	178.3	407.1	94.4	168.0	402.3
	N_{60}	237.1	421.8	703.5	206.0	385.8	617.9
	N_{90}	190.1	347.5	601.4	161.8	312.7	546.4
Assessment of the significance of partial differences							
LSD_{05}, g		A = 2.6; B = 1.9; C = 3.4					

Source: Authors' concept of the experiments

Therefore, elements of technology that increase the accumulation of dry above-ground mass are of great importance for increasing the efficiency of crop seed production. The indicator "accumulation of dry above-ground mass" has a direct effect on the yield of conditioned seeds of white sweetclover.

Table 4. The yield of conditioned seeds of sweetclover of different varieties depending on the width of the rows and doses of nitrogen fertilizer (average for 2018-2020)

Factor A, variety	Factor B, row width, cm	Factor C, nitrogen fertilizer dose, kg/ha	Yield of conditioned seeds, kg/ha A	Average by factor		
				B	C	
Pivdennyy	15	No fertilizers	238	363	303	259
		N_{30}	304			346
		N_{60}	385			413
		N_{90}	329			368
	30	No fertilizers	255		347	
		N_{30}	350			
		N_{60}	425			
		N_{90}	391			
	45	No fertilizers	290		384	
		N_{30}	429			
		N_{60}	495			
		N_{90}	437			
	60	No fertilizers	273		350	
		N_{30}	369			
		N_{60}	450			
		N_{90}	392			
Donets′kyy annual	15	No fertilizers	239	329		
		N_{30}	294			
		N_{60}	351			
		N_{90}	286			
	30	No fertilizers	259			
		N_{30}	334			
		N_{60}	393			
		N_{90}	371			
	45	No fertilizers	273			
		N_{30}	354			
		N_{60}	421			
		N_{90}	375			
	60	No fertilizers	243			
		N_{30}	331			
		N_{60}	386			
		N_{90}	359			
Assessment of the significance of partial differences						
LSD_{05}, kg/ha				A = 6.97; B = 7.18; C = 5.83		

Source: Authors' concept of the experiments

On average for the years 2018–2020, the maximum yield of conditioned annual sweetclover seeds – 495 kg/ha was ensured by the cultivation of the Pivdennyy variety with a row width of 45 cm and nitrogen fertilization with a dose of N_{60} (Table 4).

Depending on the variety composition (factor A), a larger amount of conditioned seeds, on average during the period of research, – 363 kg/ha, was obtained for sowing the Pivdennyy variety, which exceeded the similar values of this indicator in the Donets′kyy annual variety by 34 kg, or by 9.4%. On average, according to factor B (width between rows), when using a width between rows of 45 cm, the maximum yield of conditioned seeds was obtained – 384 kg/ha, with other variants of the width between rows, a decrease in the indicator was observed in the range of 34–81 kg/ha. At different doses of nitrogen fertilizer application (factor C), significant fluctuations in the values of the crop seed yield indicator were observed – from 346 to 413 kg/ha. The minimum amount of conditioned seeds – an average of 259 kg/ha was formed by annual sweetclover crops, where nitrogen fertilizer was not applied.

The maximum yield of conditioned seeds – 413 kg/ha was obtained with the application of nitrogen fertilizer with a dose of N_{60}. The smallest amount of conditioned seeds of both researched varieties was obtained with a row spacing of 15 cm on unfertilized variants – 238 and 239 kg/ha, respectively. According to the measure of the decrease in seed productivity of sweetclover, a tendency to decrease the yield of conditioned seeds and the coefficient of seed reproduction was observed (Table 5).

On average, during the 2018–2020 period of experimental research, the maximum yield of conditioned seeds per unit area – 89.0% was obtained for sowing the Pivdennyy variety with a row width of 45 cm and applying nitrogen fertilizer with a dose of N_{60}. In the Donets′kyy annual variety, the highest one-year yield of conditioned seeds – 88.0% was also observed with a row width of 45 cm and the use of nitrogen fertilizer with a dose of N_{60}. As a result, it can be concluded that the use of these parameters in the technology of cultivation of various crop varieties contributes to obtaining the largest amount of conditioned seed material.

The average coefficient of phenotypic variation (Vpf, %) of yield of conditioned seeds depending on the width of the rows was insignificant and ranged between 1.73–2.45% for the Pivdennyy variety and 1.85–2.15% for the Donets′kyy annual variety. The modification variability (Vm, %) was somewhat higher depending on the application of doses of nitrogen fertilizer and amounted to 2.65–9.26% for the Pivdennyy variety and 2.71–9.38% for the Donets′kyy annual variety, which indicates the advantages of technological regulation of yield conditioned seeds with the help of this agrotechnical measure. The average indicators of the phenotypic variation of seed reproduction coefficient of varieties under the influence of row width (Vpf, %) were significantly higher – 6.42–9.38% – for

Table 5. The yield of conditioned seeds and the reproduction ratio of the white annual sweetclover of different varieties depending on the width of the rows and doses of nitrogen fertilizer (average for 2018-2020)

Row width, cm	Pivdennyy variety									
	yield of conditioned seeds, %					seed reproduction rate				
	dose of nitrogen fertilizer, kg/ha					dose of nitrogen fertilizer, kg/ha				
	No fertilizers	N_{30}	N_{60}	N_{90}	V_m, %	No fertilizers	N_{30}	N_{60}	N_{90}	V_m, %
15	85.0	86.9	86.9	86.1	2.65	47.6	60.8	77.0	65.8	12.51
30	85.9	87.1	86.9	85.9	6.72	51.0	70.0	85.0	78.2	14.12
45	86.1	87.9	89.0	87.1	8.83	58.0	85.8	99.0	87.4	21.65
60	86.9	87.0	88.1	86.9	9.26	54.6	73.8	90.0	78.4	23.57
V_{pf}, %	1.81	2.02	2.45	1.73		6.42	8.75	9.12	9.38	
Row width, cm	Donets′kyy annual variety									
	yield of conditioned seeds, %					seed reproduction rate				
	dose of nitrogen fertilizer, kg/ha					dose of nitrogen fertilizer, kg/ha				
	No fertilizers	N_{30}	N_{60}	N_{90}	V_m, %	No fertilizers	N_{30}	N_{60}	N_{90}	V_m, %
15	85.1	85.0	86.0	86.1	2.71	47.8	58.8	70.2	57.2	12.15
30	86.0	87.2	86.0	86.1	6.54	51.8	66.8	78.6	74.2	15.04
45	86.9	87.0	88.1	87.0	8.95	54.6	70.8	84.2	75.0	22.49
60	85.0	87.1	86.9	88.0	9.38	48.6	66.2	77.2	71.8	23.78
V_{pf}, %	1.92	2.15	2.08	1.85		6.50	8.59	9.23	9.47	

the Pivdennyy variety; 6.50–9.47% – for the Donets′kyy annual variety, and modification variability under the influence of nitrogen fertilizer doses (Vm, %) – 12.51–23.57% and 12.15–23.78% for the above-mentioned varieties, respectively. This makes it possible to state that the seed reproduction coefficient of different varieties can be regulated by the parameters of the width of the rows and doses of nitrogen fertilizer.

Conclusions

It was established that the processes of accumulation of above-ground mass by culture plants depended on all the studied factors. The most favorable conditions for the formation of above-ground dry mass of sweetclover are created in the Pivdennyy variety when applying a dose of N_{60} and a row width of 45 cm. Nitrogen fertilizers significantly increased this indicator, both in the Pivdennyy variety and in the Donets′kyy annual variety. The maximum increase in the mass of dry matter was formed with a double dose of nitrogen fertilizer and was 41.3–42.5% and 34.8–40.9% relative to the varieties.

Depending on the varietal composition (factor A), the largest amount of conditioned seeds, on average during the period of research, was 363 kg/ha when sowing the Pivdennyy variety, which exceeded the similar values of this indicator in the Donets′kyy annual variety by 34 kg, or by 9.4%. On average, according to factor B (width between rows), when using a width between rows of 45 cm, the maximum yield of conditioned seeds was obtained – 384 kg/ha, with other variants of the width between rows, a decrease in the indicator was observed in the range of 34-81 kg/ha. At different doses of nitrogen fertilizer application (factor C), significant fluctuations in the values of the crop seed yield indicator were observed – from 346 to 413 kg/ha. The minimum amount of conditioned seeds, on average – 259 kg/ha, was formed by crops of annual sweetclover, where nitrogen fertilizer was not applied. The maximum yield of conditioned seeds – 413 kg/ha was obtained with the application of nitrogen fertilizer with a dose of N_{60}.

The average indicators of the phenotypic variation of seed reproduction coefficient of varieties under the influence of row width (Vpf, %) were significantly higher – 6.42–9.38% – for the Pivdennyy variety; 6.50–9.47% – for the Donets′kyy annual variety, and modification variability under the influence of nitrogen fertilizer doses (Vm, %) – 12.51–23.57% and 12.15–23.78% for the above-mentioned varieties, respectively. This makes it possible to state that the seed reproduction coefficient of different varieties can be regulated by the parameters of the width of the rows and doses of nitrogen fertilizer.

References

Antonova, E. V., Shoeva, O. Yu. & Khlestkina, E. K. (2019). Biochemical and genetic polymorphism of *Bromopsis inermis* populations under chronic radiation exposure. *Planta, 249*(6), 1977-1982.

Armin, M. J., Asgharipour, M. R. & Yazdi, S. K. (2011). Effects of different plant growth regulators and potting mixes on micro-propagation and mini-tuberization of potato plantlets. *Advances in Environmental Biology*, *4,* 631-638.

Babich, A. O. & Poberezhna, A. A. (2000). Population and food at the turn of the second and third millennia. Kyiv: *Agrarian Science* (Ua).

Bezuhlyy, M. D. & Prysyazhnyuk, M. V. (2012). The current state of reforming the agrarian and industrial complex of Ukraine. Kyiv: *Agrarian Science* (Ua).

Calvino, P. A., Andradeb, F. A. & Sadrasb, V. O. (2003). Maize Yield as Affected by Water Availability, Soil Depth, and Crop Management. *Agronomy Journal, 95,* 275-281.

Clayton, G. W., Rice, W. A., Lupwayi, N. Z. & Johnston, A. M. (2004). Inoculant formulation and fertilizer nitrogen effects of field pea: crop yield and seed quality. *Canadian Journal of Plant Science, 84,* 89-96.

Cornara, L. (2016). Therapeutic potential of temperate forage legumes: a review. *Critical Reviews in Food Science and Nutrition, 56*(12), 149-161.

Demydas', G. I. & Zakhlebaev, M. V. (2017). Density formation of white sweet clover in a singlecrop and compatible sowings with annual cereal crops. *Bulletin of the Uman National University of Horticulture, 1,* 53-56.

Denisow, B. & Malinowski, D. P. (2016). Climate change and the future of our world – implications for plant phenology, physiology, plant communities, and crop management. *Acta Agrobotanica, 69*(2), 1-4.

Gibson, J. P. & Gibson, T. R. (2006). Plant Ecology. *Infobase Publishing*.

Halwankar, G. B., Raut, V. M. & Patil, V. P. (1989). Effects os sowing dates on growth and yield of soybean. *Maharashtra Agr. Univ., 14*(1), 120-125.

Harker, K. N., O'Donovan, J. T., Blackshaw, R. E., Johnson, E. N., Lafond, G. P. & May, W. E. (2012). Seeding depth and seeding speed effects on no-till canola emergence, maturity, yield and seed quality. *Canadian Journal of Plant Science, 92,* 795-802.

Martin, J. N. (1934). The relative growth rates and interdependence of tops and roots of the biennial white sweet clover, *Melilotus alba* Desr. *American Journal of Botany, 21*(3), 140-159.

Meyer, J. (1984). Nitrogen fertilization true flood, furrow, sprinkler and drip irrigation systems. Ann. *California Fertilizer Conf., 28,* 25-26.

Nyfeler, D. (2009). Strong mixture effects among four species in fertilized agricultural grassland led to persistent and consistent transgressive overyielding. *Journal of Applied Ecology. Oxford, 46*(3), 683-691.

Özköse, A. & Tamkoç, A. (2016). Determination of Agricultural Characteristics of Smooth Bromegrass (*Bromus inermis* Leyss) Lines under Konya Regional Conditions. *International Journal* *of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering*, *11,* 681-684.

Parrish, Z. D. (2005). Bioremediation and biodegradation: effect of root death and decay on dissipation of polycyclic aromatic hydrocarbons in the rhizosphere of yellow sweet clover and tall fescue. *Journal of Environmental Quality, 34*(1), 207-216.

Rajput, M. T., Tahir, S. S., Ahmed, B. A. S. I. R. & Arain, M. A. (2008). Check list of the weeds found in cotton crops, cultivated in Taluka Ubauro, district Sukkur, Pakistan. *Pakistan Journal of Botany, 40*(1), 65.

Rigal, M. & Rigal, L. (2016). Sweet clovers, a source of fibers adapted for growth on wet and saline soils. *Journal of Natural Fibers, (13)*4. 410-422.

Rochon, J. J. & Doyle, C. J. (2004). Grazing legumes in Europa: a reviw of their status, management, benefits, research needs and future prospecrs. *Grass and Forage Science, 59*(3), 197-214.

Tristram, G. L. (2013). Functional group dominance and identity effects influence the magnitude of grassland invasion. *Journal of Ecology, 101,* 1114-1124.

Tsandur, M. O. (2006). Scientific foundations of agriculture in the Southern Steppe of Ukraine. Odesa: *Papyrus,* (Ua).

Ushkarenko, V. O., Vozhehova, R. A., Goloborodko, S. P. & Kokovikhin, S. V. (2014). Methods of Field Experience (Irrigated Agriculture). Kherson: Grin D.S.

Vlashchuk, A. M., Pryshchepo, M. M., Konashchuk, O. P. & Kolpakova, O. S. (2015). Annual white is a promising fodder crop. *Agronomist*, *3*(49), 216-218.

Vozhehova, R. A., Lavrynenko, Yu. O. & Malyarchuk, M. P . (2014). Methods of field and laboratory studies on irrigated lands. Kherson: Grin D.S.

Vozhehova, R. A., Vlashchuk, A. M., Drobit, O. S. & Vlashchuk, O. A. (2020). Productivity in detail. *The Ukrainian Farmer, 6*(126), 92–93 (Ua).

Wolf, J. J. (2004). Soil characteristics of rocky mountain national park grasslands invaded by *Melilotus officinalis* and *M. alba*. *Journal of Biogeography, 31*(3), 415-424.

Zinchenko, O. I., Salatenko, V. N. & Bilonozhko, M. A. (2003). Plant growing. Kyiv, *Agrarian Education* (Ua).

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