

**FORMATION OF ALFALFA PRODUCTIVITY FOR GREEN FODDER
DEPENDING ON LOOSENING OF SOIL IN SWARDS
DURING THE THIRD YEAR OF USAGE**

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The results of studying the impact of the terms and depth of sward cultivation on the growth and productivity of alfalfa during the third year of usage are considered.

It is well-known that alfalfa has essential feeding and agricultural importance. According to many studies, after growing of 45 – 50 t / ha of green mass of alfalfa during three – four years of usage due to its root and stubble remains, soil is enriched with so many nutrients which contained in the 60 – 80 tonnes of manure [1 – 4]. On soils of heavy-loamy structure that are easily compacted under the influence of mechanical aggregates during harvesting of alfalfa, the measures of loosening soil are important, providing improvement of its air regime and mineral nutrition of plants. In this regard, we investigated the depth and terms of soil tillage on crops of alfalfa of three-year usage. The aim of the research was to reduce the bulk density of soil using spring and tillage for enhancing growth, increasing density and the yield of alfalfa for green fodder.

Methodology of the research. Experiments were held in the fodder crop rotation of Plant Growing Department of Uman National University of Horticulture. Soil is podzolized chernozem of heavy-loamy granule-metrical structure. In the plough layer there are 3.64% of humus, 148 compounds of nitrogen, which are hydrolyzed easily, 67 moving compounds of phosphorus, and 122 mg / kg of potassium.

Sown area is 75 m², and accounting area is 25 m². Repetition in the experiment was triple. Preceded crop was winter wheat for grain. Alfalfa was self-seeded by the sowing machine SZT – 3,6 to the depth of 2 – 3 cm with seeding rate of 8 million of similar seeds per 1 ha or 16 kg / ha. In autumn mineral fertilizers were applied at the rate of P₄₅K₄₅ and in spring there was fertilizing with N₄₅. Variety of Veselopodolyanska 11 was sown. During the alfalfa sowing of third year of the agricultural machinery was used in accordance with the scheme of the experiment (Table 1).

Measure of the plants height was carried out in phases of bifurcation and budding. The volumetric weight of soil was determined according to the method of loosening in layers 0 – 10 and 10 – 20 cm. Density of alfalfa stems was determined in the budding phase.

The yield of green fodder was measured by its weighing during mowing.

Results of the research. In our experiment it was turned out that the soil is well

loosened using grooving, the cracks actively hold water, overall physical condition of soil improves, and its washout sharply reduces. During the vegetation period of alfalfa in areas where loosening by chisels was held, soil bulk density was significantly lower compared with the variant without soil cultivation (control). Thus, in the variant of grooving in spring before the first slope during loosening the soil at 14 – 16 and 18 – 20 cm, bulk density indices in the layer 0 – 10 cm were respectively 1.10 and 1.11 g/cm³, and without grooving 1.23 g/cm³ and in the layer of 10 – 20 cm, respectively – 1.15 and 1.16 g/cm³ and 1.24 g/cm³ (Table 1).

1. Indicators of bulk density of the soil during its loosening by grooving (average for 2010 – 2012), g/cm³

Variant of the experiment	Depth of loosening, cm	Before the first slope		After the third slope	
		0 – 10 cm	10 – 20 cm	0 – 10 cm	10 – 20 cm
Without cultivation (control)	–	1,23	1,24	1,26	1,34
Grooving in spring	14 – 16	1,10	1,15	1,21	1,23
	18 – 20	1,11	1,16	1,22	1,24
Grooving in autumn	14 – 16	1,13	1,17	1,23	1,25
	18 – 20	1,14	1,18	1,24	1,26

During grooving before the first slope in autumn at the 14 – 16 and 18 – 20 cm soil bulk density indices in the layer of 0 – 10 cm were also lower than control ones and were respectively 1.13 and 1.14 g/cm³, and in the layer of 10 – 20 cm – 1.17 and 1.18 g/cm³. After the third slope the topsoil was already quite packed as a result of action of harvesting machines and transport units. Thus, in the variant with grooving in spring at 14 – 16 and 18 – 20 cm in the layer of 10 – 20 cm soil bulk density was equal respectively 1.23 and 1.24 g/cm³, and in autumn – indicators slightly increased to 1.25 and 1.26 g/cm³, and in the control variant was 1.34 g/cm³.

In the variants of grooving in spring to the depth of 14 – 16 and 18 – 20 cm the plant height of alfalfa was the smallest and reached respectively to 30.7 and 31.0 cm (phase of branching) and 61.3 and 63.4 cm (phase of budding), and in control variant (without soil) – 28.9 (phase of branching) and 58.7 cm (phase of budding) (Table 2). Thus in the variant of grooving in autumn during the research of depths the alfalfa height increased accordingly to – 32.7 and 33.9 (phase of branching) and 64.1 and 65.7 cm (phase of budding). A significant increase of the plant height to control was in variants of grooving in spring and autumn within 1.8 – 5.0 cm at HIP₀₅ 1.7 (phase of branching) and – 2.6 – 7 cm at HIP₀₅ 2.4 (phase of budding).

Loosening the soil by grooving in spring to the depth of 14 – 16 and 18 – 20 cm contributed the formation of greater density of alfalfa stems, which amounted respectively 519 and 521 pieces/m² and exceeded the control on 91 pieces/m² or 21% or 93 pieces/m² or 22% (Table 3). In the variant of grooving in autumn while studying the depth of the alfalfa plants density increased to 534 and 553 pieces/m²

that is on 106 and 125 pieces/m² or 25% and 29% more compared to the control. Thicker stems of alfalfa in the variants of autumn tillage were ensured by better shoots forming, in other words on the root collar formed more buds that grew well. A significant increase of density of the alfalfa stems was in all variants of grooving both in spring and autumn compared with the variant without cultivation (control) – respectively within 91 – 125 pieces/m² at HIP₀₅ 21.2. The significant increase of plant density is observed between variants of spring and autumn grooving of alfalfa within the depths of 14 – 16 and 18 – 20 cm.

2. The height of alfalfa plants depending on the soil loosening under its sward (average for 2010 – 2012), cm

Variant of the experiment	Depth of loosening, cm	Phase of vegetation	
		branching	budding
Without cultivation (control)	–	28,9	58,7
Grooving in spring	14 – 16	30,7	61,3
	18 – 20	31,0	63,4
Grooving in autumn	14 – 16	32,7	64,1
	18 – 20	33,9	65,7
<i>HIP</i> ₀₅		1,7	2,4

3. Effect of soil tillage under swards on density of alfalfa stems (second mowing, phase of budding) pieces/m²

Variant of the experiment	Depth of tillage, cm	Index		
		2010 – 2012	Increase	
			pieces/m ²	%
Without cultivation (control)	–	428	–	–
Grooving in spring	14 – 16	519	91	21
	18 – 20	521	93	22
Grooving in autumn	14 – 16	534	106	25
	18 – 20	553	125	29
<i>HIP</i> ₀₅		21,2	–	

In variants of spring grooving to the depth of 14 – 16 and 18 – 20 cm the crop capacity of green mass of alfalfa reached respectively 36.2 and 37.4 t / ha, with increase to the control – 3.3 and 4.5 t / ha or 10% and 13% (Table 4). During autumn grooving to the depth of 14 – 16 and 18 – 20 cm the crop capacity of green mass of alfalfa was the largest and was equal respectively 39.1 and 40.3 t / ha, with an increase to the control – 6.2 and 7.4 t / ha or 18 and 22%.

4. The total crop capacity of green mass yield of alfalfa for the three mowings depending on soil tillage under sward, t / ha

Variant	Depth of ploughing, cm	2010 – 2012	Increase to the control	
			t/ha	%
Without cultivation (control)	–	32,9	–	–
Grooving in spring	14 – 16	36,2	3,3	10
	18 – 20	37,4	4,5	13
Grooving in autumn	14 – 16	39,1	6,2	18
	18 – 20	40,3	7,4	22
<i>HIP₀₅</i>		1,9	–	

Results of statistical analysis of yielding data show that the use of grooving is accompanied by a significant increase in the yield of alfalfa for green forage in all the studied variants compared with control. The maximum level of increase of the crop capacity of green mass was provided by grooving in autumn to the depth of 18 – 20 cm with the index 7.4 t/ha at HIP_{05} 1.9 t / ha. The increase of harvest of alfalfa for green fodder in all variants of grooving in autumn was significant compared to spring one. Also the experiment revealed that the increase of crop capacity of green mass of alfalfa during deepening of tillage from 14 – 16 to 18 – 20 cm was negligible for both periods.

Owing to such cultivation as alfalfa tillage after the third mowing, the optimum volumetric weight of soil was achieved; the plant height, density of stems, crop capacity of green mass and improvement of productivity indices were increased. Thus, in the variant of grooving in spring to the depth of 14 – 16 and 18 – 20 cm gather of dry weight was respectively equal to 9.0 and 9.3 t / ha, and during autumn grooving it increased to 9.7 and 10.0 t / ha (Table 5). During grooving of alfalfa in autumn to the depth of 18 – 20cm the highest increase of feed units 1.6 t / ha or 21.9% crude protein and 0.27 t / ha or 23.6% was received.

5. Productivity of alfalfa depending on loosening of the soil in the sward (2010 – 2012), t/ha

Variant	Depth of ploughing, cm	Dry mass	Fodder units	Increase		Crude protein	Increase	
				t / ha	%		t / ha	%
Without cultivation (control)	–	8,2	7,3	–	–	1,14	–	–
Grooving in spring	14 – 16	9,0	7,8	0,5	6,8	1,26	0,12	10,5
	18 – 20	9,3	8,1	0,8	10,9	1,30	0,16	14,0
Grooving in autumn	14 – 16	9,7	8,5	1,2	16,4	1,35	0,21	18,4
	18 – 20	10,0	8,9	1,6	21,9	1,41	0,27	23,6

Conclusions. Grooving of soil under sward of alfalfa of the second year of usage in autumn after the third mowing to the depth of 18 – 20 cm provides optimum volume weight – 1.26 g/cm³ in the soil layer of 10 – 20 cm, the greatest plant height is 65.7 cm, density of stems – 553 pieces/m², crop capacity of green mass – 40.3 t / ha and collecting of fodder – 8.9 t / ha and crude protein – 1,41 t / ha.

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Формирование производительности люцерны на зеленый корм в зависимости от рыхления почвы в травостоях третьего года использования

При долотования люцерны весной перед первым укосом и осенью после третьего укоса при рыхлении на 18 – 20 см объемная масса почвы в слое 10 – 20 см равнялась соответственно, 1,16 и 1,18 г/см³, а в контрольном варианте (без долотования) — 1,24 г/см³.

После третьего укоса люцерны верхний слой почвы был уже достаточно уплотненным вследствие действия уборочных машин и транспортных агрегатов. При этом в варианте долотования весной и осенью при рыхлении почвы на 18 – 20 см в слое 10 – 20 см объемная масса достигла соответственно 1,24 и 1,26 г/см³, а в контрольном варианте — 1,34 г/см³.

При долотовании весной на глубину 18 – 20 см высота растени была наименьшей и равнялась 31,0 см (фаза ветвления) и 63,4 см (фаза бутонизации), а при рыхлении осенью ее показатели увеличились до 33,9 и 65,7 см.

Рыхление почвы весной на глубину 18 – 20 см обеспечивало густоту стеблестоя 521 шт./м² и увеличение его против контроля на 22%, а рыхление осенью способствовало большему его увеличению до 553 шт./м² или на 29%.

При долотовании люцерны весной на глубину 18 – 20 см урожайность ее зеленой массы равнялась 37,4 т/га, а прирост — 4,5 т/га или 13%, при проведении этого рыхления осенью показатели увеличились и равнялись соответственно 40,3 т/га, 7,4 т/га или 22%.

В варианте долотования люцерны осенью на глубину 18 – 20 см получен наибольший сбор кормовых единиц — 8,9 т/га, с приростом 1,6 т/га, или 21,9%, а также — сырого протеина — 1,41 т/га, с приростом 0,27 т/га или 23,6%.

***Ключевые слова:** объемная масса, долотование, рост, стеблестой, зеленая масса, продуктивность, кормовые единицы, сырой протеин.*

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Formation of alfalfa productivity for green fodder depending on loosening of soil in grass density during the third year of usage

While grooving of alfalfa in spring before the first mowing and in autumn after the third mowing at loosening by 18 – 20 cm soil bulk density in the layer of 10 – 20 cm was respectively, 1.16 and 1.18 g/cm³, and in the control variant (without grooving) — 1.24 g/cm³.

After the third mowing of alfalfa topsoil was already sealed due to the action of cleaning machines and transport units. In the variant of grooving in spring and in autumn when loosening of soil in the 18 – 20 cm of layer of 10 – 20 cm, respectively, the bulk density reached 1.24 i 1.26 g/cm³, and in control version — 1.34 g/cm³.

While grooving in spring to the depth of 18 – 20 cm, height of the plants was lower and reached 31.0 cm (phase of branching) and 63.4 cm (phase of budding), and during autumn loosening its rates have increased to 33.9 and 65.7 cm.

Loosening of soil in spring to the depth of 18 – 20 cm provided the thickness of stalks in 521 per m² and its increase against the control to 22%, and loosening in autumn brought greater increase of it to 553 pieces per m² or 29%.

While grooving alfalfa in spring at the depth of 18 – 20 cm its yield of green mass was equal to 37.4 t / ha, while the increase — 4.5 t / ha, or 13%, while loosening in autumn rates have increased, respectively, and were equal to 40.3 m / ha 7.4 t / ha, or 22%. In the variant of grooving of alfalfa in autumn to the depth of 18 – 20 cm, the largest gathering of fodder units — 8.9 t / ha was gathered, with the gain of 1.6 t / ha, or 21.9%, and — crude protein — 1, 41 t / ha, with the gain of 0.27 t / ha, or 23.6%.

***Key words:** bulk density, grooving, growth, stams density, green mass, productivity, feed units, crude protein.*