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NUTRITION OF WINTER INTERMEDIATE CROPS DEPENDING ON TECHNOLOGICAL FACTORS OF CULTIVATION

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Key words: winter triticale, green conveyor, green fodder, nutrition, fodder units

Abstract

One of the main components of the successful management of the livestock industry is the use of traditional and less common forage crops in the feed conveyor links, different in the rate of green mass growth and balanced in the protein content. Annual fodder plants, including winter triticale, play a significant role in the system of such a conveyor. Field research was conducted at the Agronomic Research Station of the National University of Life and Environmental Sciences of Ukraine on typical low-humus chernozems. The object of research was winter crops: wheat (control), rye (control) and triticale (early ripening variety AD44, mid-ripening variety Polissky 29, late ripening variety ADM 11), sown in five calendar dates. It has been established that sowing winter triticale at the most optimal time, in accordance with the biological requirements of varieties, allows not only to control the production process in crops, but also to control the quality and nutritional value of the fodder mass. Due to their properties to synthesize proteins and carbohydrates, an important zootechnical characteristic of plants is their ability to provide high foliage of the aboveground mass. Among the studied varieties of winter triticale, the maximum leafiness was provided by the variety Polisskiy 29–34.2–35.3 %. Depending on the time of sowing and variety, mowing the vegetative mass of triticale in the earing phase provides a yield of 3.22–8.23 t / hectare of feed units and 0.39–1.07 t / hectare of digestible protein. The supply of feed unit protein was 114–132 g / feed units.

ПИТАТЕЛЬНОСТЬ ОЗИМЫХ ПРОМЕЖУТОЧНЫХ КУЛЬТУР В ЗАВИСИМОСТИ ОТ ТЕХНОЛОГИЧЕСКИХ ФАКТОРОВ ВЫРАЩИВАНИЯ

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Ключевые слова: тритикале озимое, зеленый конвейер, зеленый корм, питательность, кормовые единицы

Аннотация

Одной из главных составляющих успешного ведения отрасли животноводства является использование в звеньях кормового конвейера традиционных и малораспространённых кормовых культур, разных по темпам наращивания зелёной массы и сбалансированной по содержанию протеина. В системе такого конвейера значительную роль играют однолетние кормовые растения, в том числе, тритикале озимое. Полевые исследования проводили на Агрономический исследовательской станции Национального университета биоресурсов и природопользования Украины на чернозёмах типичных малогумусных. Объектом исследований были озимые культуры: пшеница (контроль), рожь (контроль) и тритикале (раннеспелый сорт АД 44, среднеспелый сорт Полесский 29, позднеспелый сорт АДМ 11), высеяны в пять календарных сроков. Установлено, что сев тритикале озимого в наиболее оптимальные, в соответствии с биологическими требованиями сортов, сроки позволяет не только управлять продукционным процессом в посевах, но и контролировать качество и питательность кормовой массы. Благодаря своим свойствам синтезировать белки и углеводы важной зоотехнической характеристикой растений является их способность обеспечивать высокую облиственность надземной массы. Среди исследуемых сортов тритикале озимого максимальную облиственность обеспечивал сорт Полесский 29–34,2–35,3 %. В зависимости от срока сева и сорта скашивание вегетативной массы тритикале в фазе колошения обеспечивает выход 3,22–8,23 т/га кормовых единиц и 0,39–1,07 т/га переваримого протеина. При этом обеспеченность кормовой единицы протеином составляла 114–132 г/корм. од.

Introduction

Successful management of the livestock industry is impossible without well-established feed production, since it is not only a source of realizing the genetic potential of animal productivity, but also an important item in the formation of the cost of the product produced [1, 2, 3]. However, as practical experience shows, a farm with a set for growing 5–6 fodder crops does not fully cope with the task. This is due to the limited period of their use and the imbalance of feed in terms of digestible protein content, which predetermines a sharp rise in the price of livestock products through overconsumption of feed [4, 5, 6]. In this regard, it is relevant to search for non-traditional plants that can not only compete with well-known crops, but surpass them in terms of economically valuable indicators and resistance to unfavorable climatic conditions, have wide ecological plasticity, ensure consistently high productivity and be one of important factors of ensuring sustainable development of feed production [7, 8, 9]. A rational way out of this situation is the use in the links of the feed conveyor of traditional and rare forage crops, different in the rate of growth of green mass, balanced in the protein content and the period of its intake. In the system of such a conveyor, an important role is played by annual fodder plants [10, 11, 12], for example, winter triticale.

It is known that the vegetative mass of winter grain crops is used for fodder purposes in the period from the phase of emergence into the tube to the phase of full earing, since at this time the green mass is the most balanced and complete for animal nutrition [13]. However, not only crops, but also their varieties differ significantly in chemical composition and nutritional value of green mass. Affects the metabolic processes in the plant organism and the shift in the calendar sowing dates. Based on this, the research was supposed to study and develop the technological basis for increasing the productivity of varieties of winter triticale of different early maturity.

Materials and methods

Field research was conducted at the Agronomic Research Station of the National University of Life and Environmental Sciences of Ukraine on typical low-humus chernozems. The humus content in the arable layer is 4.34–4.68 %, pH is 6.8–7.3, the absorption capacity is 30.7–32.5 meq per 100 g of soil.

The object of research was winter crops: wheat (control), rye (control) and triticale (early ripening variety AD44, mid-ripening variety Polissky 29, late ripening variety ADM 11), sown in five calendar dates.

The size of the sowing area is 36 m², the counting area is 25 m². The placement of variants is systematic, the recurrence – four times. Predecessor – corn for silage.

Results and discussion

When growing winter grain crops for green fodder, an important characteristic of the fodder value of varieties and the productivity of crops in general is the morphological structure of the grown crop, since various plant organs differ significantly in their chemical composition [5]. In this regard, the value of the share of each component in the total mass of plants has a significant effect on the chemical composition, and, consequently, the zootechnical value and nutritional value of the feed.

The structure of the vegetative mass of winter cereals includes three main components: stems, leaves and ears. Due to its properties to synthesize proteins and carbohydrates, the most nutritious part of the green mass is leaves [3]. Consequently, an important zootechnical characteristic of plants is their ability to provide high foliage of the aboveground mass.

The obtained observation results indicate that the dynamics of the morphostructure of the vegetative mass of triticale is significantly influenced by the sowing time, harvesting phases and biological characteristics of the variety. It was revealed that the highest leafing of rye, wheat and triticale is observed in the steam elongation phase – 53.0–54.2, 50.7–52.1, 52.3–60.5 %, respectively. Among the researched varieties of triticale, varieties AD3/5, AD44 and ADM 9 differed in a relatively low proportion of the leaf component in the structure of the yield – 52.3–55.5 %. However, even with such triticale values, winter wheat of all sowing dates prevailed.

Before the onset of the heading phase, there was a decrease in leafiness of plants on crops of all experimental variants, which was explained by the death of the heading, a decrease in the leaf surface area, and growth of the stem and ear (**table 1**).

Table 1

The structure of the vegetative mass of winter crops, %

Sowing time	Culture, variety	Elements of the structure, %		
		stems	leaves	stems
25.08.	rye	72,8	17,9	9,3
5.09.		72,3	18,1	9,6
15.09.		72,6	18,3	9,1
25.09.		72,8	18,2	8,9
05.10.		73,1	18,2	8,7
25.08.	wheat	58,4	27,8	13,8
5.09.		57,6	28,2	14,2
15.09.		57,9	28,4	13,7
25.09.		57,9	28,7	13,4
05.10.		57,7	29,2	13,2
25.08.	triticale AD44	56,3	31,0	12,7
5.09.		55,6	31,3	13,1
15.09.		55,7	31,8	12,5
25.09.		55,9	31,9	12,2
05.10.		55,6	32,5	11,9
25.08.	triticale Polisske 29	56,5	34,2	9,2
5.09.		55,5	34,6	9,9
15.09.		55,8	35,1	9,1
25.09.		56,3	35,1	8,6
05.10.		56,3	35,3	8,4
25.08.	triticale ADM 11	56,4	31,7	11,9
5.09.		55,5	32,1	12,4
15.09.		56,0	32,4	11,7
25.09.		56,2	32,5	11,3
05.10.		56,2	32,8	11,1

The smallest proportion of leaves in the structure of the vegetative mass was formed by the AD44 variety – 31.0–32.5 %. The maximum leafing was provided by the Polisskiy 29 variety – 34.2–35.3 %. Regardless of the factors studied, the highest leafiness of plants during heading was observed when sowing was performed in the period from September 15 to October 5.

With the onset of the flowering phase, the percentage of leaves in the structure of the vegetative mass in rye, wheat and triticale did not exceed 7.8–8.4, 17.0–17.5 and 17.1–23.0 %, respectively. The Polisskiy 29 variety turned out to be the most productive in terms of the content of leaves in the yield structure – 21.8–23.0 %.

Simultaneously with an increase in overall productivity (harvesting green mass and dry matter), intensification of fodder production provides for an increase in the yield of fodder protein and fodder units, the collection of which per unit area is closely correlated with the size of the yield and is an important criterion for the productive properties of herbage. This is especially important when planning the feed conveyor, in which the animals must be provided with high-quality plant feed on a daily basis.

Research have established that in the steam elongation phase, triticale crops ensured the collection of feed units at the level of 1.03–1.75 t/hectare, while wheat – 0.85–1.12, rye – 1.60–2.43 t/hectare. During steam elongation phase, not a single triticale variety exceeds winter rye after the yield of feed units, however, relative to winter wheat, the increase is 0.38–0.46 t/hectare. The most productive in terms of collecting feed units were AD44 (1.22–1.75 t/hectare) and Polisskiy 29–1.14–1.69 t/hectare. The indicated varieties were dominated by the rest of the triticale varieties and for the collection of digestible protein – respectively, 0.18–0.26 t/hectare. Due to the insufficiently powerful herbage on the October crops, the yield of fodder units did not exceed 1.03–1.22 t/hectare, while when sowing on September 15 it was 1.69–1.75 t/hectare. The same dependence on the sowing time was noted for the collection of digestible protein – 0.18–0.20 and 0.24–0.26 t/hectare, respectively.

With an increase in the yield of the vegetative mass before the onset of the heading phase, an increase in the collection of both feed units and digestible protein was noted (**table 2**).

Mowing the vegetative mass of triticale during heading, according to research, made it possible to collect 3.22–7.92 t/hectare of fodder units and 0.39–0.97 t / hectare of digestible protein, depending on the sowing period and variety. Under similar growing conditions, rye crops provided 3.99–7.14 t/hectare of feed units and 0.52–0.91 t/hectare of digestible protein. All studied crops formed low productivity when sown on October 5.

Before the onset of the flowering phase, a decrease in the content of digestible protein was observed in all experimental variants. This was mainly due to a decrease in the proportion of the leaf component in the structure of the vegetative mass. Due to the long-term functioning of the leaf apparatus, the Polissky 29 variety turned out to be highly productive, according to this indicator, during flowering – 0.44–0.75 t/hectare. The growth of the specified variety to winter wheat was 0.34, to rye – 0.12 t/hectare.

One of the main challenges in creating a solid fodder base is to ensure the optimal feed protein requirement for animals. With a lack of protein in the diet, animals cannot fully use the fats and carbohydrates contained in feed, which leads to their significant cost overruns and an increase in production costs. In addition, prolonged protein starvation disrupts the normal physiological functions of the body, not only reduces productivity, but also impairs the breed qualities of animals [14, 15, 16]. First of all, the overconsumption of feed for the production of a unit of livestock products is associated with the content of digestible protein in the feed unit. One of our tasks was to study the effect of the provision of a feed unit with digestible protein, depending on the sowing time and biological characteristics of the variety.

Table 2

The productivity of winter crops in the heading phase depending on the sowing time, t/ha

Culture, variety	Sowing time					The average	Difference to		
	25.08.	5.09.	15.09.	25.09.	05.10.		average	wheat	rye
Ingathering of feed units, t/ hectare									
Rye	6,69	6,62	7,14	5,41	3,99	5,97	0,51	3,23	St
Wheat	2,46	3,26	3,59	2,92	1,49	2,74	–2,71	St	–3,23
AD44	5,22	6,01	7,41	5,60	4,15	5,68	0,22	2,93	–0,29
Polisske 29	5,87	6,26	7,92	5,94	4,29	6,06	0,60	3,31	0,09
ADM 11	4,92	5,42	7,11	5,17	3,22	5,17	–0,29	2,43	–0,80
The average	5,31	5,78	7,16	5,34	3,69	5,46			
Difference to average	–0,14	0,33	1,70	–0,12	–1,76	–	–	–	–
HIP_{05} general = 0,72									
Ingathering digestible protein, t / hectare									
Rye	0,82	0,82	0,91	0,70	0,52	0,75	0,08	0,40	St
Wheat	0,32	0,42	0,47	0,39	0,20	0,36	–0,32	St	–0,40
AD44	0,61	0,73	0,91	0,70	0,52	0,69	0,02	0,34	–0,06
Polisske 29	0,69	0,74	0,97	0,75	0,55	0,74	0,06	0,38	–0,01
ADM 11	0,56	0,63	0,84	0,61	0,39	0,61	–0,07	0,25	–0,15
The average	0,64	0,71	0,89	0,67	0,47	0,68	–	–	–
Difference to average	–0,04	0,03	0,21	0,00	–0,21				
HIP_{05} general = 0,088									

The maximum supply of a feed unit of digestible protein in all experimental variants was noted in the steam elongation phase: in rye, wheat and triticale, respectively, 144–153, 142–149 and 137–154 g/fodder units. It was also revealed that the content of digestible protein, and, consequently, the provision of a feed unit with it in all crops grows in the direction from early to late sowing dates. Obviously, this is due to the different spectral composition of sunlight during the development of plants with different sowing dates and with increased air temperatures, which in turn contribute to the accumulation of mobile forms of nitrogen in the soil, primarily nitrate. In this regard, most crops, sown at a later calendar date, accumulate nitrogen-containing compounds more intensively. So, if during sowing on August 25 the supply of a fodder unit of green mass with triticale was 137–139 g/fodder units, then sowing on October 5 contributed to the formation of 144–154 g/fodder units. Thus, the lower yield on October crops was to some extent compensated by the high value of the fodder mass. The same pattern was observed on the crops of the original parental forms (control).

Before the onset of the heading phase, due to the intensive growth of the vegetative mass, as a result of the "dilution" phenomenon, a decrease in the protein content in the green mass of all winter crops was noted (**table 3**).

As a result, this led to a decrease in the provision of a feed unit with protein: in rye – up to 123–130 g/fodder units, wheat – up to 128–133 g/fodder units, triticale – 114–127 g/fodder units.

Before the onset of the flowering phase, the supply of the fodder unit sharply decreased: in rye – up to 79–86 g/fodder units, wheat – up to 90–97 g/fodder units, triticale – 80–100 g/fodder units. The decrease in the vegetative mass of nitrogenous substances was caused by the intense death of the leaves of the lower layers. The highest supply of a fodder unit during flowering is characteristic of the Polissky 29 variety, a feature of which is the elongated functioning of the leaf apparatus.

Conclusions

Sowing winter triticale at the most optimal time, in accordance with the biological requirements of varieties, allows not only to control the production process in crops, but also to control the quality and nutritional value of the fodder mass.

Table 3

Provision of a fodder unit of digestible protein, g/f.u.

Culture, variety	Sowing time					The average	Difference to		
	25.08.	5.09.	15.09	25.09	05.10		average	wheat	rye
Heading phase									
Rye	123	124	128	129	130	127	2,26	–3,57	St
Wheat	128	128	130	132	133	130	5,83	St	3,57
AD44	117	121	123	125	125	122	–2,15	–7,98	–4,41
Polisske 29	118	118	122	126	127	122	–2,15	–7,98	–4,40
ADM 11	114	116	117	118	121	117	–7,13	–12,96	–9,39
The average	120	123	125	126	128	124	–	–	–
Difference to average	–4	–2	0	2	3	–	–	–	–

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