Scientific and practical justification of haylage harvesting in APC "Levochsky" Novgorod region

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There are three options for harvesting haylage: haylage in the trench, haylage with separate packaging, haylage with the preparation of rolls in line. The comparative assessment above the listed technologies of harvesting haylage on the basis of APC "Levochsky" Khvoyinsky district of Novgorod region is given. According to the results of scientific and practical research, the lowest cost of finished products is achieved when using the option of harvesting of haylage with roll packing in line. A wrapper-wrapper is used for this technology.

Section 1

The most important condition for the creation of a solid fodder base in the farm is the preparation of high-quality vegetable fodders using modern progressive technologies that maximize the yield of nutrients from a unit of land area and preserve 85-90% of them in the process of storing.

The wide spread of haylage in recent years is explained by the fact that harvesting makes it possible to obtain more nutrients from the same area, to reduce the number of components in the diet, to reduce the cost of livestock products in comparison with silage and hay.

The most important condition for obtaining high-quality feed is the creation of anaerobic storage conditions that exclude air access in the preparation of haylage from cured grasses. Such conditions are achieved by compaction of the hay mass and hermetic covering of the storage. If the mass is properly sealed, its temperature should not exceed 35-37°C.

The use of the senile towers allows fully mechanizing the processes of laying the mass, its seizure and delivery to the places of feeding. And it also reduces storage losses.

The towers with the upper type of unloading mass are the most widespread among tower storages. Filling of such towers is carried out with the help of special equipment. Crushed mass from the field is delivered to the tower, where it is reloaded by a grader loader into the feeder-feeder, dosed and pneumatically loaded into the tower through hatches in the walls of the tower.

Trenches of ground, semi-buried and buried type are used for laying haylage because of the lack of tight towers. At present, ground trenches made of prefabricated reinforced concrete are widely used. Trenches of buried and semi-buried type should be lined with reinforced concrete slabs, the floors should be concreted [2].

The loss of dry matter during storage of haylage is 10% with proper observance of the technique trench filling with fodder and its coverage. If the technological requirements are not met, the losses increase to 40-70% [1].
Section 2

The most promising technology of haylage currently is haylage in plastic packaging that avoids the difficulties and disadvantages of the conventional technologies (haylage in trenches and towers). According to the experience of the advanced economies, haylage in the package allows the increase of nutrient feeds by approximately 20% and provides a fully balanced food for animals, as well as its effective use. An increase in productivity of the animals by 20 ÷ 25% is achieved and the cost of dry concentrate feed and livestock production cost is reduced.

In recent years, high-speed packers are used in polymeric packaging, which pack rolls into a "line" and there is no need to wrap the ends of rolls, which saves 30-40% of the film, compared to the individual winding of each roll. It is recommended to put on special caps on the end sides of the formed lines for a high-quality sealing. This technology does not require the transfer of packed rolls to the storage location, which eliminates damage to the film. The line can have unlimited length, which allows using the storage area.

The main advantage of this packing method is high productivity of work - 100÷110 rolls per hour or 500 ÷600 tons per shift, which is comparable to the volume of the whole trench of haylage.

A comparative assessment of haylage harvesting technologies is given in the table1.

Table 1. A comparative assessment of haylage harvesting technologies.

| Cost item                                      | Haylage in the trench | Single packed haylage | Haylage with packing of rolls in a line |
|-----------------------------------------------|-----------------------|-----------------------|----------------------------------------|
| Mowing of herbs with squashing, rub/ha        | 622                   | 622                   | 622                                    |
| Turning, rub/ha                               | 261                   | 261                   | 261                                    |
| Raking, rub/ha                                | 226                   | 226                   | 226                                    |
| Pressing, rub/ha                              | –                     | 682                   | 682                                    |
| Loading of rolls, rub/ha                      | –                     | 277                   | 277                                    |
| Transportation to the storage place, rub/ha   | 2834                  | 946                   | 946                                    |
| Packing of rolls per packing, rub/ha          | –                     | –                     | 278                                    |
| Packing of rolls (including the cost of the film), rub/ha | – | 4327 | 2411 |
| Stowage of packed rolls, rub/ha               | –                     | 285                   | –                                      |
| Pickup of grass mass with grinding, rub/ha    | 1663                  | –                     | –                                      |
| Leveling and tamping of the mass, rub/ha      | 3426                  | –                     | –                                      |
| Sheltering with film, rub/ha                  | 220                   | –                     | –                                      |
| **Amount of expenses, rub/ha**                | **9246**              | **7636**              | **5687**                              |
| Amount of expenses per 1 ton, rub/ha          | 912                   | 762                   | 576                                    |
| Average losses of the haylage mass (during harvesting, storage, feeding), % | 15-30 | 0-5 | 0-05 |
| **Cost of finished products including losses, rub/ha** | **1177** | **789** | **599** |

Section 3

The agricultural production cooperative "Levochsky" is one of the leading enterprises of the Novgorod region. The own forage base available in the farm makes it possible to fully provide the livestock with quality fodders, with the exception of concentrated forages. It is practiced to prepare forage from the rolled grain, packed in a polymeric sleeve.

The main performance indicators of APC "Levochsky" are given in table 2.

Table 2. Indicators of the farm unit in 2014-2016.
At present, the APC Levochsky stores haylage in ground trenches. Every year more than 1,000 tons of haylage are stored on the farm, which, in combination with hay and silage, makes it possible to completely provide the livestock with feed. The machine and tractor fleet is able to produce all technological operations for harvesting plant fodder. The main problem in the preparation of haylage in the farm is the insufficient number and unsatisfactory condition of silage-haylage trenches, which require significant investments in the overhaul of structures. Due to the lack of concrete storage, part of the feed is stored in earth trenches for storage. This leads to a decrease in the quality of the resulting haylage and a significant increase in its losses during storage. Low quality of plant fodder when feeding a milking herd leads to a surplus of concentrates and sharply raises the cost price of meat and milk.

The technology of harvesting of haylage in APC "Levochsky" includes the following operations:
- Mowing grass with squashing (tractor MTZ-826 + trailed mower-conditioner KRONE EasyCut 280, self-propelled mower-conditioner E-302);
- Turning (tractor MTZ-82,1 + rotary ripper Krone KW-6/72);
- Shoveling grass mass into the roll (tractor MTZ-82,1 + Rotary swath former Krone swadro 807);
- Pickup of mass from rolls, followed by grinding, application of a preservative and unloading into a vehicle (forage harvester DON-680M, forage harvester MARAL -125);
- Transportation of crushed mass to the storage location (tractor T-150K + semitrailer PIM -40, tractor John Deere 730 + semitrailer PPS -15);
- Distribution and tamping of the ground mass into a trench (John Deere 730 tractor, loader JCB 531-70AG);
- Sheltering of a trench with a film;
- Sheltering of the trench with ballast (loader JCB 531-70AG).

A technological map was developed for APC "Levochsky" for harvesting haylage by packing coils into polymer film, which is presented in table 3.

Polymer "Agrostreich" film is used for hermetic winding of rolls on the technology "haylage in packing". It is made from three layers of high-density polyethylene by casting method. The film has considerable resistance to tears and punctures, and also has the ability to resiliently stretch up to 75%. For winding rolls of haylage in a line, a wrapper is used, which is an autonomous machine and has its own gasoline internal combustion engine with a capacity of 12-15 hp, which ensures the operation of all the units of this wrapper. This machine moves independently on the haylage packing site, and the tractor is required only to move it along public roads. The working process is carried out by means of...
a hydraulic system, which includes a hydraulic pump, a hydraulic motor, a hydraulic distributor, control levers, pusher and rear wheel hydraulic cylinders, hoses and connectors [1].
The area of perennial grasses - 100 hectares
The yield of perennial grasses is 135 dt/ha
The volume of harvested sennage is 1150 tons
The average distance to the storage place is 5 km.

Table 3. Technological map for harvesting haylage by packing rolls in polymer film.

| № | Works                        | Volume of works, ha. (t) | Terms of work | Composition of unit machinery | Personnel, people | Productivity | Number of machines | Labor costs, p., p/ha | Fuel costs, kg/ha | Operating expenses | Total   |
|---|------------------------------|--------------------------|---------------|------------------------------|-------------------|--------------|-------------------|----------------------|-------------------|--------------------|---------|
| 1 | Grass mowing                 | 50                       | 6             | 10                           | E 302             | 1            | 3.2               | 25.6                 | 0.31              | 6.1                | 9.6     | 213    | 76     | 4.4     | 303    |
|   | Grass mowing                 | 50                       | 6             | June                         | MTZ EasyCut       | 826          | 1                 | 4                    | 3.2               | 0.25              | 6.8                | 8.2     | 238    | 68     | 4.8     | 319    |
| 2 | Turning                      | 100                      | 6             | June                         | MTZ              | 826          | 1                 | 6                    | 48                | 0.16              | 2.6                | 7.2     | 182    | 64     | 6       | 260    |
| 3 | Raking                       | 100                      | 6             | June                         | MTZ              | 82.1         | 1                 | 6                    | 48                | 0.16              | 2.6                | 7       | 154.8  | 58     | 5.2     | 225    |
| 4 | Pressing rolls               | 50                       | 6             | June                         | MTZ              | 82.1         | 1                 | 30                   | 1 (240)           | 0.45              | 7                  | 9.2     | 225    | 87     | 8.1     | 330    |
|   | Pressing rolls               | 50                       | 6             | June                         | MTZ              | 82.1         | 1                 | 22                   | 1 (18)            | 0.58              | 7.1                | 9.2     | 257    | 75     | 9.4     | 351    |
| 5 | Uploading on transport       | (1150)                   | 6             | June                         | MTZ              | 82.1         | 1                 | (50)                 | (14)              | 0.26              | 3.3                | 7.1     | 195    | 69     | 7.2     | 276    |
| 6 | Transportation               | (1150)                   | 6             | June                         | KamAZ            | 45143        | 1                 | (48)                 | (384)             | 0.28              | 13                 | 9.3     | 857    | 70     | 10.2    | 947    |
| 7 | Uploading on wrapper         | (1150)                   | 6             | June                         | JCB              | 531-70AG     | 1                 | (50)                 | (400)             | 0.26              | 3                  | 7.3     | 179    | 82     | 6.8     | 276    |
| 8 | Packaging rolls              | (1150)                   | 6             | June                         | Roll packer      | -            | 1                 | (50)                 | (400)             | 0.26              | 1                  | 9       | 56     | 61     | 2279    | 2405   |
| Total |                          |                          |               |                             |                   |              |                   | 2.9                  | 52.7              |                   | 5695    |        |        |        |
Section 4
The calculation of the economic efficiency of the technology of harvesting of haylage with winding of rolls in a line is made in comparison with the technology of harvesting of haylage in concrete trenches used in APC "Levochsky". The initial data for the calculation are taken from the annual report of the farm for 2016.

The use of the proposed technology for harvesting haylage with packing of rolls in a line showed its advantages in comparison with the technology used previously. The results of economic efficiency are presented in table 4.

Table 4. Comparative technical and economic efficiency.

| №  | Indicators                              | Options          |
|----|----------------------------------------|------------------|
|    |                                        | Basic | New       |
| 1  | The volume of harvested fodder, t.      | 1150  | 1150      |
| 2  | Costs for the production of fodder, rub.| 1050065 | 672010 |
| 3  | Capital expenditures, rub.              | –     | 787000    |
| 4  | Capital expenditures, rub.              | –     | 378055    |
| 5  | Payback period of capital investments, months. | –     | 24      |

Along with saving money spent on harvesting haylage, the quality of haylage will improve, which will effectively affect the productivity of animals.

References
[1] The patent of the Russian Federation for utility model №103439 The packer of rolls / M. F. Zakirov et.al., 2011.
[2] Ten A,G, Fodder production. -M.: Kolos, 1982. – 463p.