

PROBLEMS OF PRODUCTION AND USE OF HYDROPONIC PRODUCTS IN AGRICULTURAL PRODUCTION

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Abstract: Production of hydroponic green fodder is an important task of agriculture, which in developed countries is given enough attention. Currently, the world's developed a considerable number of various designs installations for the production of hydroponic products, but the main working body of these installations are trays in which the cultivation of hydroponic green fodder, as one of the most simple, but fairly effective devices for seeding, cultivation and the ready products. The main global trends in the production of hydroponic green fodder, as one of the components of the diet of poultry and cattle, are considered. The paper analyzes the operation of the workshops for the production of hydroponic products equipped with the facilities of the new design developed by us. Compared some economic characteristics of hydroponic workshops manufactured in foreign countries and developed in Ukraine. Thus, the conclusion is obvious – domestic plants for the production of hydroponic green fodder are more economical than their foreign counterparts.

KEY WORDS: BEET TOPS, CLEANING, CONTINUOUS CUT, EXPERIMENTAL STUDIES.

1. Introduction

The forecast of long-term development of farm-production in the state, subsidiary and farmer enterprises puts, now, a number of qualitatively new tasks connected with power, labor, material and environmental problems. The solution of these tasks substantially depends on technical equipment of these productions, implementation of advanced technologies, the standard of work and ability to be independent of nature conditions. However, the arisen energy crisis caused by the process of price liberalization and the rupture of economic ties practically rejected all production technologies existing earlier in agriculture as economically unprofitable. Objectively, the task arose of finding new technological approaches that drastically reduce the consumption of fuel, labor, electricity and other material resources. Especially disastrous situation has developed in such industries as livestock and poultry due to the lack of traditional feed (which was felt before), as well as the lack of feed and vitamins, previously supplied centrally. In this regard, there was a problem of developing year-round production of additional feed, which allows to balance feed rations throughout the year. Conditions of their production have to be such that any farm, leaning on the labor and financial resources, could master their production easily. The hydroponic method of cultivation of green and protein feeds meets these requirements. Hydroponic green fodder is six times cheaper than grass meal and five times cheaper than compound feeds without taking into account nutrient loss during storage. And most importantly – the production of this environmentally friendly feed does not depend on the time of year.

2. Purpose of the study

Consider the main global trends in the production of hydroponic green fodder, outline ways to solve this problem that is important for agricultural production, scientifically substantiate and develop domestic technologies and means of mechanization.

3. Results and discussion

In Ukraine, the cultivation of hydroponic green fodder began as early as the 30s, but so far has been constrained by the imperfect quality of technological processes and the low level of their mechanization. In such highly developed countries of the world as England, Austria, Spain, Portugal, USA, France, Japan, the hydroponic method of growing green fodder is one of the main methods in feed production. For the production of hydroponic green fodder there are widely used, mainly, multi-tiered plants, which are located in the ground premises, high-rise greenhouse towers and underground horizons of exhausted mines. Saving land in the production of hydroponic products is not less 96-98 %.

However, hydroponic plants exported by these countries are

very expensive, which excludes the possibility of their wide and affordable purchase. The importance of the problem under consideration requires the urgent and scientifically grounded development of domestic technologies and means of mechanization that provide the necessary set of technological processes that would be economically beneficial for enterprises with various forms of management - state agricultural enterprises, farms, poultry farms, breeding farms, etc. We are conducting fundamental research, the purpose of which is to develop integrated scientific and technical foundations for creating means of mechanizing the production of hydroponic feeds, ensuring optimal design and layout solutions for the conditions of technological processes, which significantly reduce energy and material consumption, labor costs and ensure the economic feasibility of their mass use in production.

Based on the conducted research, a number of practically important results were obtained. Thus, it was experimentally proved that with the norms of sowing barley, oats, wheat 5.5 kg·m⁻², peas 5 kg·m⁻², with a cultivation period of 7 days, the yield of total green mass of hydroponic feed is 45...55 kg·m⁻². The technological process of growing green fodder takes place at a temperature of 20...25°C and humidity 85...90%. Watering is done 6 times a day - 4 times with water and two with a nutrient solution developed at the Institute of Poultry Farms of the National Academy of Agrarian Sciences of Ukraine, and the temperature of the water and solution should not exceed 15...16°C, which excludes the development of fungal diseases. From the total mass of hydroponic feed grown, green is 12...13 kg·m⁻², and the amount of dry matter is 7...8 kg·m⁻². Growing green fodder occurs when the illumination is 600...700 lux and the length of daylight is 15 hours per day. By chemical composition, hydroponic green fodders practically do not differ from those grown abroad and are environmentally friendly.

For the implementation of the described technology, the scientific basis for calculating, designing and evaluating the performance of multi-tier mechanical hydroponic installations with rigid supporting columns and qualitatively new design features of trays on which hydroponic products are grown is developed. [1, 2, 3]. Physical and mechanical properties of the tray design allow for unloading the crop and returning it to its original position under the action of gravity without additional energy and labor costs (Patent of USSR № 1512629). Such plants are equipped with hydroponic workshops in Ukraine at the PPS "Dubrovsky" and the PF "Leninskaya". Also, theoretically justified and practically implemented is the acceptability for operation in a number of farms of new types of designs of hydroponic installations with carrying ropes (Patent of USSR №1628983, №15122528, №1732872). To assess the performance of hydroponic systems with elastic carrier elements, we developed parametric criteria characterizing the dynamic stability of these systems, which were used as the basis for calculating and designing existing installations. The foundations of the dynamic theory of calculation and design of qualitatively new

hydroponic installations with rotating modules were created. [3, 4]. The long-term practice of operating hydroponic plants suggests that the systems developed are simple to manufacture, reliable in operation and significantly reduce energy and labor costs compared to foreign analogues of equal performance.

Studies have found that when using hydroponic green fodder as a vitamin supplement, the following daily allowances are recommended for animals and poultry: for milk cows – 5...8 kg, calves – 200...300 g, suckling pigs – 80...100 g, pig sows – 1.5...2.0 kg, sheep's – 0.5...1.0 kg, piglets and lambs up to two months of age – 100...150 g, broilers – 15...20 g, laying hens – 20...25 g, chickens – 8...19 g, ducks – 40...45 g, geese – 50 g.

As the main feed for one cow with a calf, the diet of hydroponic green fodder is at least 50 kg per day. These standards improve the general physical condition of animals and birds and significantly reduce a number of diseases (avitaminosis of birds, cows' meatiness, poor development of young animals, weak fertility of eggs, etc.).

We note the increase in live weight of animals and birds, in the nutritious diet of which hydroponic green food is added. Experiments to determine the increase in live weight of birds in different age periods were carried out at the poultry farm "Nadezhda", PS "Krasnoflotsky" and PPS "Dubrovsky" since 2009. As a result of processing the obtained source material using PC, it was found that the increase in live weight of broiler chickens at the age of five weeks of the experimental group is 15...17% higher than the control. The discrepancy between the live weight of broilers aged 8 weeks reached an average of 18% in favor of the experimental group. The same increase in live weight was observed when comparing the experimental indicators of laying hens and hens of the egg line. Similar experiments were conducted with ducks of different breeds of different ages. The discrepancy between body weight on average reached 20%. An approximate increase in live weight was observed when comparing individual experimental indicators of the control and experimental groups of geese and turkeys. It should be noted that before feeding hydroponic green fodder to the bird of a breed herd of PPS "Dubrovsky" in the egg there were 17...19 mg·kg⁻¹ carotene and 6...8 mg·kg⁻¹ provitamin A, and daily eating 20 g of green feed increased the content these elements, respectively, up to 30...35 mg·kg⁻¹ and 10...12 mg·kg⁻¹. The content of carotene in the liver of day-old chicks who consumed hydroponic green food almost doubled. The egg production of laying hens increased by 15...17 pcs. eggs compared with the control group. In 2012–2016, a number of experiments were conducted at the "Nadezhda" poultry farm and the PPS "Dubrovsky" to determine the effect of hydroponic green fodder on the increase in live weight of pigs and calves. For experimental studies, two groups of piglets were selected: control - 19 heads, experimental - 22 heads. Starting from the third week, the piglets of the experimental group were given 100 g of hydroponic green fodder, and at 7 and 8 weeks – 150 g. When comparing the results of the experiment, it was found that at two months of age the piglets of the control group had an average weight of 17.4 kg, and the experimental group 20.8 kg. The experiment to determine the effect of hydroponic green fodder on the increase in live weight of calves was conducted at the "Nadezhda" poultry farm during the period from March 10 to April 29, 2016. The control group contained 4 calves, five in experimental group. The increase in average live weight of calf of experimental group was 18% higher than control group.

It should be noted that all experiments on birds and animals were carried out in the autumn-winter or winter-spring periods. Thus, the results of experimental studies suggest that hydroponic green food has a significant positive effect on the physical condition and increase in live weight of animals and birds.

Let's compare some economic characteristics of hydroponic workshops manufactured abroad and developed in Ukraine. We confine ourselves to the consideration of workshops with the productivity of growing hydroponic green fodder no more than 3.5 tons of green mass per day. This limitation is due to the fact that there are no workshops in the Ukrainian farms whose productivity exceeds that indicated. Moreover, the work of foreign workshops of

small (75...1000 kg per day) and medium (1000...3500 kg per day) productivity is well covered in the available documentation and literature. The latter allows you to compare more realistic economic indicators. For basic, when calculating economic indicators, with equal performance, we take: seeding rate, water consumption, yield, growing time, total electricity consumption, total weight of plants, cost of 1 ton of feed. Consider specific foreign workshops. Hydrodan (England) manufactures Landsaver hydroponic installations (H-1000) with a capacity of 1000 kg of green feed per day. Close to the technological and technical parameters of hydroponic installations produces well-known Spanish company FPV-1200. The seeding rate of dry grain is 7.2 kg·m⁻², water consumption is 1.0...1.2 m³ per day, the yield is 50 kg·m⁻², the cultivation period is 8 days. The total daily electricity consumption by hydroponic installations H-1000 is 120 kWh, FPV is 185 kWh (round-the-clock lighting), the total mass of the workshop is 6 tons, the cost of 1 ton of feed is 3.65 USD. Approximately equal in performance hydroponic workshops at the PPS "Dubrovsky" and at the "Nadezhda" poultry farm: sowing rate 5.5 kg·m⁻², irrigation combined with a daily water consumption of 0.65 m³, yield 50 kg·m⁻², the total power consumption: PPS "Dubrovsky" – 29.7 kWh, poultry farm "Nadezhda" – 37.4 kWh, the total mass of plants with equipment is 4.2 tons and 4.8 tons, the cultivation period is 7 days, the cost of one ton of hydroponic green fodder is 1.35 USD. The Austrian company LMF produces installations for the production of hydroponic products with a capacity of 3.3 tons per day. Sowing rate is 6 kg·m⁻², combined watering with a daily water consumption of 20 m³, yield 55 kg·m⁻², growing time 6 days, total consumption electricity 144.4 kWh, the number of staff – 4, the cost of 1 ton of grown green fodder is 2.85 USD. A hydroponic workshop of similar performance, equipped with eight three-tiered 12-meter installations, is operated at the PS "Krasnoflotsky" substation. Sowing rates, irrigation and yield are the same as at the "Nadezhda" poultry farm, the daily water consumption is 13 m³, the total energy consumption is 38 kWh, the number of operators is 2, the cost of grown 1 ton of green fodder is only 1.25 USD. Thus, the conclusion is obvious - domestic plants for the production of hydroponic green fodder are more economical than their foreign counterparts.

4. Conclusions

Thus, in the operation of workshops for the production of hydroponic products equipped with installations of the new design developed by us [4], with equal performance with foreign counterparts, the total energy consumption is 2.5...3.0 times less, 2 times less than the mass of the installations and auxiliary equipment, and the cost of 1 ton of green fodder grown on plants developed by us is 2.5...3.0 times lower than foreign. The latter is achieved by quantitative and qualitative perfection of technological processes of growing feed, financial costs for the metal and the necessary materials for the manufacture of plants and the design features of the systems, which significantly save the main energy sources.

5. References

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