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## The Formation of The Quality of Maize, Depending on The Density of Plants and Fertilizers.

SA Semina\*, and IV Gavryushina.

Federal State Educational Institution of Higher Education «Penza State Agricultural University» Address: 440014, 30, Botanical st., Penza, Russian Federation.

### ABSTRACT

The article presents the results of studies on the formation of the quality of the green mass of maize depending on the density of plants and the level of mineral nutrition. It was found that the biochemical composition of corn was most affected by the improvement in the nutritional state of plants, and the thickening of the sowing did not cause significant changes in the biochemical composition of the feed. The greatest influence on the accumulation of protein substances in maize biomass was provided by nitrogen fertilization, which contributes to the growth of crude protein, on average, by 2.49%. The growth of protein harvest is traced to the density of plants of 80 thousand / ha. The increase of fat in the biomass was facilitated by the introduction of mineral fertilizers in doses N120P90 and N120P90K60. The studied agro-practices practically did not affect the change in the concentration of exchange energy in the feed. The addition of exchange energy from nitrogen-phosphorus fertilizers was 22.2-30.2% compared with the unfertile versions.

**Keywords:** mineral fertilizers, density of plants, maize, biochemical composition, protein, exchange energy.

*\*Corresponding author*

## INTRODUCTION

Maize is widely used as a silage crop. Therefore, the determination of the concentration and ratio of essential nutrients in maize plants is of great importance in modern feed production. The more nutrients in the feed, the higher its nutritional status [1-5].

The fodder merits are to a certain extent determined by the content and collection of the protein. The green mass of maize is distinguished by high fodder qualities, but it contains insufficient amount of protein substances.

A number of researchers noted that the introduction of mineral fertilizers helps to reduce the amount of fiber in the green mass and the increase in the content of crude protein [6-8].

Due to its high energy content, corn silage is considered a good food for dairy and beef cattle [9-12].

## METHODOLOGY OF RESEARCH

The research was carried out in 2015-2017 on the basis of the Konstantinovo CJSC of the Penza District of the Penza Region. To solve the problems, two-factor experience was laid down by the method of split plots in fourfold repetition according to the scheme:

Factor A - fertilizer dose: 1 - N0P0K0; 2 - N120P90; 3. N90P90 + N30; 4.N120P90K60. Factor B - the density of plant standing: 1. 60 thousand pieces / ha; 2. 70 thousand pieces / ha; 3. 80 thousand pcs / ha; 4. 90 thousand pieces / ha; 5. 100 thousand pieces / ha.

The sowing was carried out with a row spacing of 70 cm. The density of plant standing was formed in the phase of full shoots. Predecessor - winter wheat on a black fallow. Object of research: early-ripening (FAO 190) double interlinear hybrid of maize ROSS 199 MV.

## RESULTS

When studying fodders, attention is mainly drawn to the content of the main nutrients in them, which ensure the plastic and energy aspects of metabolism. It is known that the most important nutrient of any feed, including green, is protein.

The results of the biochemical analysis showed a regular increase in the crude protein in dry biomass when mineral fertilizers were introduced. However, depending on the year of testing, various features are traced.

For three years of testing it was found that the greatest influence on the accumulation of protein substances in maize biomass was provided by nitrogen fertilizing, which contributed to the growth of crude protein by 2.49% on average, compared to the unfertilized agro background, and by adding nitrogen a supplement of 1,3% was obtained (Table).

The supplementation of nitrogen-phosphorus fertilizer with potassium had no significant advantages over the introduction of N120P90 on the accumulation of protein by plants. At these levels of mineral nutrition, the increase in protein substances was 1.18-1.42% in comparison with the unfertile variants. There is a tendency of reduction of the crude protein content in green mass as the density of plant life increases. It should be noted that the dry matter of feed grown in hotter years, compared with those grown in moderately warm years, is characterized by a lower protein content and a high content of nitrogen-free extractives.

On average, for three years of research no significant trend in the content of crude fiber depending on the doses and methods of application of fertilizers and the density of plant standing was revealed.

Fats have a high calorie content, so they are a source of energy in the body of animals. In rations of animal there should be 3-5% of fat in dry matter. It should be noted that the fat content in the years of studies and variants of the experiment did not show great differences, a biomass with a fat content of 2.00-3.29% was obtained.

**Table - Biochemical composition of maize (average for 2015-2017)**

| Dose of fertilizer | Density of standing, thousand pieces / ha | Content in dry matter,% |               |         |         |                           |            |           | Digestible protein |                      | Exchange energy, MJ / kg of dry matter |
|--------------------|---|-------------------------|---------------|---------|---------|---------------------------|------------|-----------|--------------------|----------------------|--|
|                    |   | raw protein             | raw cellulose | raw fat | raw ash | nitrogen-free extractives | phosphorus | potassium | % on dry matter    | g / kg of dry matter |  |
| NOPOKO             | 60  | 6,40                    | 26,01         | 2,68    | 4,06    | 60,85                     | 0,16       | 0,93      | 4,16               | 40,83                | 10,3                                   |
|                    | 70  | 6,28                    | 24,76         | 2,49    | 4,04    | 62,43                     | 0,17       | 1,01      | 4,08               | 40,36                | 10,5                                   |
|                    | 80  | 6,26                    | 25,22         | 2,59    | 3,65    | 62,28                     | 0,17       | 1,04      | 4,07               | 40,00                | 10,5                                   |
|                    | 90  | 5,91                    | 25,10         | 2,38    | 3,82    | 62,79                     | 0,18       | 0,98      | 3,84               | 37,37                | 10,5                                   |
|                    | 100                                       | 5,87                    | 24,80         | 2,28    | 3,94    | 63,11                     | 0,17       | 1,06      | 3,82               | 37,60                | 10,5                                   |
| N120P90            | 60  | 7,33                    | 24,37         | 2,89    | 3,73    | 61,68                     | 0,21       | 1,05      | 4,76               | 47,63                | 10,6                                   |
|                    | 70  | 7,55                    | 24,62         | 2,94    | 4,41    | 60,48                     | 0,19       | 1,06      | 4,91               | 48,61                | 10,6                                   |
|                    | 80  | 7,59                    | 24,81         | 3,06    | 3,67    | 60,87                     | 0,21       | 1,03      | 4,93               | 49,58                | 10,5                                   |
|                    | 90  | 7,18                    | 25,06         | 2,95    | 4,12    | 60,69                     | 0,24       | 1,10      | 4,67               | 46,83                | 10,5                                   |
|                    | 100                                       | 6,93                    | 25,88         | 2,73    | 4,05    | 60,41                     | 0,24       | 1,09      | 4,50               | 45,23                | 10,3                                   |
| N90P90 + N30       | 60  | 8,69                    | 24,58         | 2,45    | 4,53    | 59,75                     | 0,22       | 1,01      | 5,65               | 55,14                | 10,6                                   |
|                    | 70  | 8,84                    | 26,32         | 2,57    | 4,44    | 57,83                     | 0,22       | 0,95      | 5,74               | 56,22                | 10,3                                   |
|                    | 80  | 8,96                    | 24,06         | 2,71    | 4,443   | 59,84                     | 0,22       | 1,06      | 5,20               | 58,28                | 10,7                                   |
|                    | 90  | 8,43                    | 25,19         | 2,51    | 4,66    | 59,21                     | 0,21       | 1,02      | 5,48               | 51,11                | 10,5                                   |
|                    | 100                                       | 8,23                    | 24,78         | 2,40    | 4,17    | 60,42                     | 0,23       | 0,99      | 5,35               | 51,96                | 10,5                                   |
| N120P90K60         | 60  | 7,69                    | 24,79         | 3,10    | 3,99    | 60,43                     | 0,24       | 1,23      | 4,99               | 49,35                | 10,5                                   |
|                    | 70  | 7,90                    | 26,18         | 3,09    | 4,59    | 58,24                     | 0,22       | 1,26      | 5,14               | 50,80                | 10,3                                   |
|                    | 80  | 7,60                    | 24,36         | 2,92    | 4,58    | 60,54                     | 0,23       | 1,32      | 4,94               | 48,91                | 10,6                                   |
|                    | 90  | 7,36                    | 26,21         | 2,75    | 4,32    | 59,36                     | 0,22       | 1,29      | 4,78               | 47,96                | 10,3                                   |
|                    | 100                                       | 7,23                    | 24,90         | 2,85    | 4,02    | 61,00                     | 0,22       | 1,25      | 5,00               | 46,55                | 10,5                                   |

It is established that the application of mineral fertilizers in doses of N120P90 and N120P90K60 in comparison with unfertilized soil contributes to the increase of fat in biomass. With fractional addition of nitrogen, the amount of fat in the feed decreases slightly.

The total amount of ash characterizes the mineral nutritional value of the feed. In vegetable feeds there are few ash substances and they are distributed unevenly. With regard to the accumulation of the mineral part of the dry matter of the grown fodder, it should be noted in general that the content of crude ash varied from 3.04 to 4.64% in the corn biomass, and there was no clear pattern of the influence of the root nutritional level and plant density on the mineral composition of the feed.

The group of nitrogen-free extractives (NFE) includes all nitrogen-free substances, with the exception of fat and crude fiber. The main part of nitrogen-free extractive feed substances (NFE) is carbohydrates - water-soluble (sugars) and insoluble in water (starch). In general, according to this indicator, it can be said that among all the nutrients in the green mass, NFE occupy the first place, accounting for 48.46-68.48% of the dry matter of the feed. Moreover, the doses of mineral fertilizers and thickening of crops for the concentration of NFE were negligible. The greater influence on the accumulation of nitrogen-free extractives was exerted by weather conditions during the vegetative period. In a more favorable hydrothermal regime in 2016, the content of NFE in biomass was the largest - 65.70-68.47%. And least of all NFE was contained in the forage obtained in the conditions of moderate temperatures of vegetation in 2017 - 48.46-56.63%.

During the years of research both on the unfertilized agro background and when introducing nitrogen-phosphorus fertilizers, a feed with a potassium content of 0.81-1.10% was obtained, which is close to the optimal level for animals. Full mineral fertilizing contributed to the accumulation of potassium in the biomass to 1.19-1.34%, which is 1.2-1.3 times higher than the optimum for animals in the feed.

Phosphates of sodium and potassium participate in the processes of absorption of nutrients in the intestine and release products of cellular metabolism from the body. The results of biochemical research show that the content of phosphorus, as well as potassium, depends on the doses of mineral fertilizers. When nitrogen-phosphoric and complete mineral fertilizers are introduced, the content of phosphorus increases from 0.16-0.18% on an unfertilized background to 0.19-0.24% when fertilizers are applied. But in all variants of the experiment, the feed was obtained not corresponding in terms of phosphorus content to zootechnical requirements, the phosphorus content was almost one and a half to two times lower than the zootechnical requirements. The density of plant standing had no effect on the accumulation of potassium and phosphorus in the production.

Thus, the biochemical composition of corn was most affected by the improvement in the nutritional status of plants, and the thickening of the sowing did not cause significant changes in the biochemical composition of the feed.

During the years of research, the most protein provided biomass was obtained with the application of mineral fertilizers - on the average, according to the variants 47.58-54.54 g / kg, which is 8.35-15.31 g / kg higher than the background of natural fertility (Table). Against all backgrounds of root nutrition, thickening of crops led to a decrease in protein supply of phytomass by 2.40-3.18 g / kg. With the collection of digestible protein, the variants with full mineral fertilizer and nitrogen fertilizing were practically equivalent.

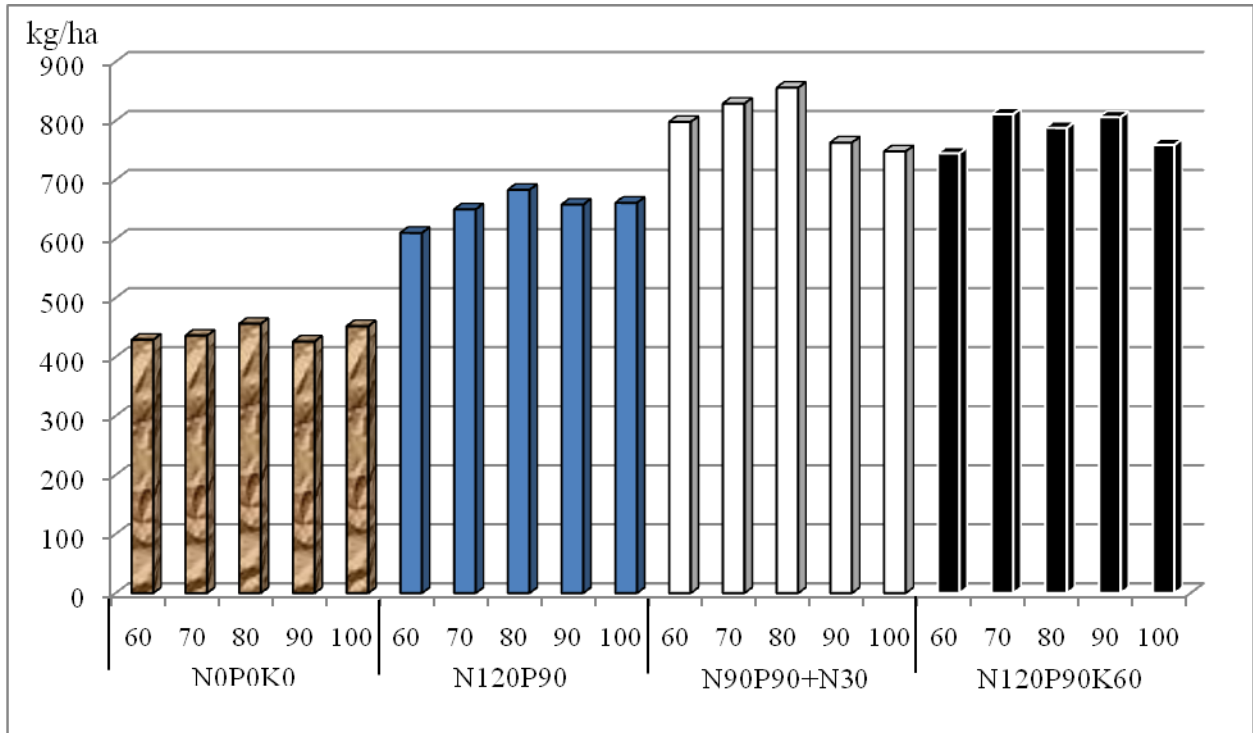
The increase was 342-358 kg / ha, and from a one-time application of nitrogen-phosphorus fertilizers, the yield of the protein increased by 212 kg / ha or 48.2% with respect to the natural agrobackground (Figure 1).

There is an increase in the collection of digestible protein to a density of 80,000 / ha, and then there is a slight decrease. It should be noted that the increase in protein intake occurred due to an increase in the protein content of the phytomass, as well as by increasing the yield.

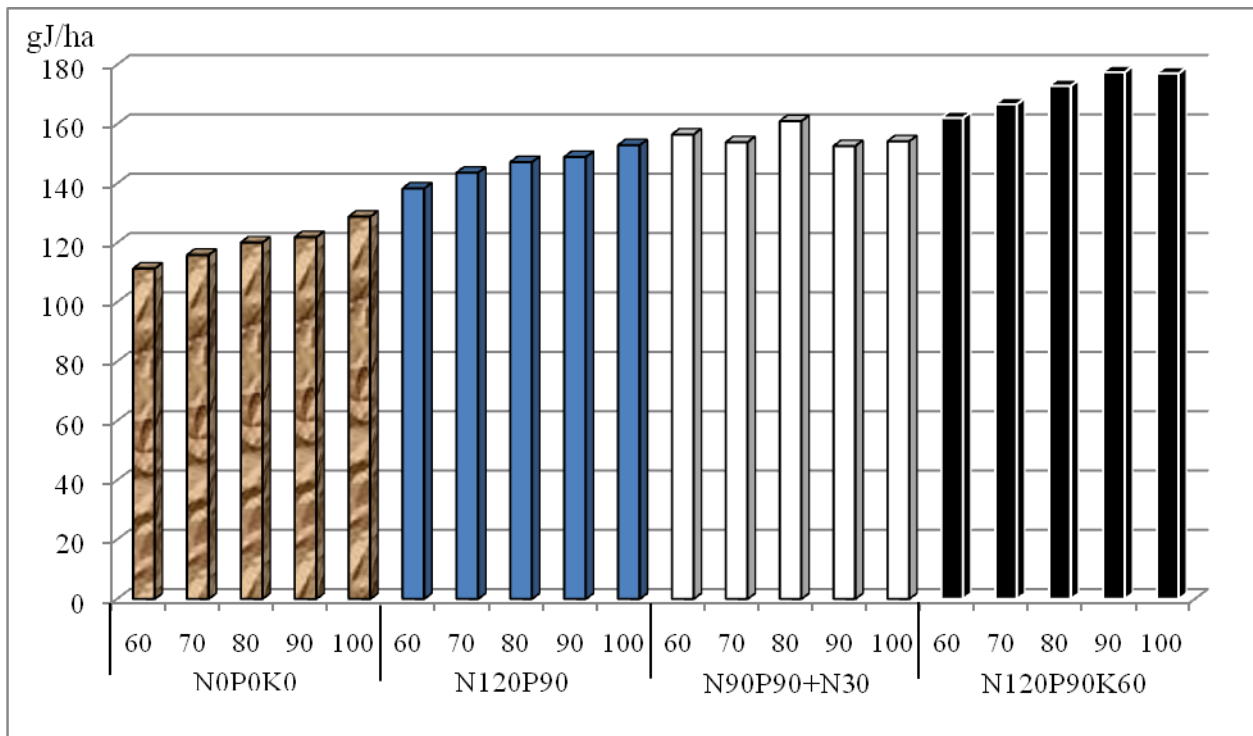
At present, great importance is attached to the energy supply of the animal organism.

It was found that more energy-saturated food was received in the warm summer of 2016 - 11.3-11.6 MJ / kg of dry matter, and less energy-assured, in 2017 - 8.9-9.8 MJ / kg of dry matter. It was revealed that the studied agro-practices had practically no effect on the change in the concentration of exchange energy in the feed (Table). The maximum yield of exchange energy was obtained when mineral fertilizers were applied at a dose of N120P90K60, mainly due to higher yields in these variants - an average of 170.0 GJ / ha, which is 42.1% higher than the background of natural fertility (Table, Figure 2 ).

The increase of nitrogen-phosphorus fertilizers was 26.6-36.1 GJ / ha or 22.2-30.2% compared to the non-favored options. Transferring a portion of nitrogen to the fertilizer contributed to an increase in the output of the exchange energy by 9.5% compared to the dose of N120P90.



**Figure 1: Influence of mineral fertilizers and plant densities on the collection of protein (average for 2015-2017).**



**Figure 2: Influence of cultivation methods on the yield of exchange energy (average for 2015-2017)**

With the thickening of the sowing and the increase in the yield of dry biomass, an increase in the yield of exchange energy on an unfertilized background was noted, and when N120P90 was added up to 100,000 pieces / ha, and up to 80,000 pieces / ha against a background of nitrogen feeding, and when N120P90K60 was used - up to 90 thousand pieces / ha.

The increase of nitrogen-phosphorus fertilizers was 26.6-36.1 GJ / ha or 22.2-30.2% compared to the non-favored options. Transferring a portion of nitrogen to the fertilizer contributed to an increase in the output of the exchange energy by 9.5% compared to the dose of N120P90.

### CONCLUSIONS

1. The biochemical composition of corn was most affected by the improvement in the nutritional status of plants, and the thickening of the sowing did not cause significant changes in the biochemical composition of the feed.

2. The greatest influence on the accumulation of protein substances in maize biomass was provided by nitrogen fertilizing, which contributed to the growth of crude protein, on average by 2.49%. The increase in fat in the biomass was facilitated by the introduction of mineral fertilizers in doses N120P90 and N120P90K60. The growth of protein harvest is traced to the density of plants of 80 thousand / ha.

3. The accumulation of nitrogen-free extractives was more influenced by the weather conditions of the vegetative period, while the doses of mineral fertilizers and the thickening of the crops had a negligible effect.

4. Full mineral fertilizing contributed to the accumulation of potassium and phosphorus in the biomass, and the density of plants did not affect the accumulation of these elements in the production.

5. It was revealed that the studied agro-practices had practically no effect on the change in the concentration of exchange energy in the feed. When nitrogen-phosphorus fertilizers were used, the output of exchange energy increased by 22.2-30.2% compared to the non-recommended options.

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