

## APPLYING OF MANURE TO WINTER WHEAT ÎN BESSARABIA

Gheorghe PRIPA

State Agrarian University of Moldova, 44 Mircesti, 2049, Chisinau, Republic of Moldova

Corresponding author email: gheorghe.pripa@gmail.com

### Abstract

*In the Republic of Moldova for a long time was considered, that manure applied to winter wheat in recommended doses (40-60 t/ha) contains too much nitrogen and leads to lodging of plants, lower production and its quality. Therefore the winter wheat is incorporated only chemical fertilizers. At the same time, in neighboring countries (Romania, Ukraine) for fertilization of wheat, frequently are using organic fertilizers at lower doses (10-20 t/ha). The dates obtained in long-term experiments demonstrate, that to this crop can be used manure in the autumn, at the dose 20 t/ha. In the case, when the manure is applying to the forerunner of wheat, the dosage may be increased up to 40-60 t/ha. Wheat, fertilized with manure is relatively low: content of crude protein and crude gluten is only 23.1 and 13.12% respectively when we incorporated into the soil 20 t/ha manure. To increase quality indicators is necessary to incorporate foliar nitrogen.*

**Key words:** manure, winter wheat, crude protein, crude gluten.

### INTRODUCTION

Currently, intensive agriculture can't be exploited without applying of mineral or organic fertilizers. The share of fertilizers in the crop formation of cereals yields in Moldova is about 25-30% (Zagorcea, 1990). In recent years, cost of fertilizers, agricultural machinery, petroleum products rose sharply, but the prices of agricultural products have remained quite low. As a result, the farmers procure and applied a low doses of fertilizers, gaining small profits and decreases soil fertility. In this situation increase the role of local fertilizer, containing all necessary nutrients for plants, increasing the humus content and improving the physical properties of the soil. They have a very low cost and applied in equivalent doses (based on content of NPK) ensure obtaining the same yield increase as the mineral fertilizers. Meanwhile, the local fertilizers are voluminous, require significant expenditure for transporting in the field, have relatively low nutrients content (NPK 13-15 kg per 1 ton), can't be applied to all crops and at all stages of plants development.

In Moldova, for winter wheat are recommended to apply only mineral fertilizers (Recommendations on use of fertilizers in Moldova, 1994). Manure is using often to

maize, sugar beet, fodder beet, most vegetables. With manure, applied at recommended doses (40-60 t/ha), is administered relatively much nitrogen (200-300 kg/ha), contributing to the fall of wheat plants, reducing yields and quality of production. From this cause, manure should not be used for spiked crops, including and winter wheat. However, other countries are applying the manure to the winter wheat. For example, in Romania condition doses of manure, applied for wheat is only 15-20 t/ha, increase of yield is exceed 1500 kg/ha (<http://www.agricultor.ro/article/36901/Graul/7>). Other authors from Romania (<http://agroromania.manager.ro/articole/diverse/gunoitul-de-grajd-un-ingrasamant-universal-13423.html>) recommended for wheat only 10-15 t/ha manure. În forest-steppe zone of Ukraine for winter wheat recommended to administrate 20 t/ha manure, which ensures a harvest addition of 4.9 q/ha on podzolic and at 4.8 to 6.6 q/ha on the typical chernoziom soils (<http://fermerland.com/rastenievodstvo/zernovy-e-kultury/pshenitsa/353>). Popov (2011) studied the growing influence of different doses (1.8, 3.6 and 5.4 t/ha) dry and granulated poultry litter for winter wheat, on the chestnut soils, in irrigation conditions. The author has established, that the crop growth was 0.3; 0.98 and 1.68 t/ha corresponding. In Moldova, there are a few data about of the manure application

for winter wheat. Therefore, the problem of winter wheat fertilization with organic fertilizers is less studied in our country, and the available data are often conflicting.

## MATERIALS AND METHODS

The studies were conducted in long stay experience at Experimental Station "Chetrosu", of State Agrarian University of Moldova. The soil is calcareous chernoziom, which containing in arable layer: 3.2% humus, mobile phosphorus approximately 1.5 mg/100 g dry soil, exchangeable potassium 18 mg/100 g dry soil. Scheme of experience included variants with different annual dose of manure (3.3, 6.6, 9.9 and 20t/ha), that corresponds to 20, 40, 60 and 120 t / ha, applied for one rotation. Studies have been conducted in 6-rotation fields with following crop rotation: silage corn - winter wheat - winter wheat - corn / beans - spring barley - sunflower. Fertilizers were applied in the first culture. Only one variant included the application of manure at a dose of 20 t/ha each year (direct action for each crop in rotation, including and winter wheat). The experiment was conducted in 3 replicates. The total area of the plots was 220-440 m<sup>2</sup>. We had use semi-fermented manure, obtained from cattle and the total content of nitrogen, phosphorus and potassium was - 0.5; 0.25 and 0.6% respectively. The results were statistically enterpreted by Dosphehov (1979).

## RESULTS AND DISCUSSIONS

În the Republic of Moldova conditions, it is recommended to use only mineral fertilizer (autumn in plowing), while seeding and during the growing season). The very high price of mineral fertilizers and rather small profits of farmers, requires us to seek other sources of plant nutrients, much cheaper as manure. This organically fertilizer is not recommended to apply to winter wheat in the Republic of Moldova, but in long-term experience, which including and winter wheat, we study the residual action of manure (in the second and third years after its incorporation). Only in one version was incorporated the manure each year, at a dose of 20 t/ha.

The data obtained show us that in the second year after incorporation 3.3; 6.6; 9.9 to 20 t / ha of manure were obtained corresponding to 480, 660, 820 and 1430 kg/ha grains, compared to control (Table 1). The dose of manure was higher, much higher it was the grain harvest. It is explained by the fact, that we have incorporated different dozes of nitrogen, phosphorus and potassium - N100P50K120, N200P100K240, N300P150K360 and N600P300K720 respectively, with increasing dose of manure (20, 40, 60 and 120 t/ha). Increasing the dose of manure at 20 to 40 t/ha lead to increased the yield by 280 kg/ha more grains, compared to control, but increasing the dose of manure at 40 to 60 t/ha - only to 160 kg/ha grain, compared with previous dose. Therefore, increasing the dose of manure at 40 to 60 t/ha is not profitable, because does not contribute to a significant increase of wheat harvest. Application of 20 t/ha manure every year, including and winter wheat, helped to achieve the highest yield added -1430 kg/ha. The effect of applied manure in this variant is not observed only in winter wheat, but to also of previous crops.

Incorporated of different doses of manure in forerunner winter wheat was not contributed to the lodging of plants, due to excess of nitrogen. It is explained by the fact, that approximately 20-30% of the nitrogen was used for working culture (corn silage). A part of nitrogen migrated to the lower layers of the soil. But even the version where each received annually 20 t/ha manure obtained about 1.5 t/ha yield increase, fall of plants was not observed. Similar yield increases have been achieved in Romania (<http://www.agricultor.ro/article-36901/Graul/7>). Perhaps this can be explained by a using of a significant portion of nitrogen (20-30%) by corn silage. Part of the nitrate nitrogen migrated into below layers of the soil, during of the vegetation season. Therefore, manure can be incorporated in the soil, on nearby fields of livestock farms, in doses at 10-20 t/ha, without fear that the winter wheat plants will fall.

Manure is considered as slow-acting fertilizer that slowly decomposes, releasing gradually certain amount of NPK. In some stages of plant development (twinning, taxidermy, grain formation), N requirement of the plants is

higher, relative to the amount of released from manure. In this case appear the symptoms of nitrogen deficiency in plants and grain quality is low.

Zagorcea (1990) mentions, that in the second year after application of manure, plants using only 10-15% of NPK and 5-7% in the third year. Therefore, the application of 20, 40 and 60 t/ha and 120 t/ha manure, wheat plants will be used in the second year 10-15, 20-30, 30-45 and 60-90 kg/ha nitrogen properly. Such amounts of nitrogen can't cause the fall of wheat plants, but do not contribute to obtaining high - quality productions. The data of crude gluten and crude protein content in wheat grains demonstrates (Table 1), that these indices on control variant were 23.6 and 12.41% respectively. Action retained of the

increasing doses of manure (20, 40 and 60 t/ha), applied in the preceding culture did not change significantly the production quality (crude gluten - 20.1, 23.0 and 21.8% and crude protein - 10.81, 11.69 and 11.64% respectively). Probably, it is obvious, that the decomposition of the organic fertilizer gradually releases a small amount of nitrogen, comparatively with plant requirements, especially during grain formation, which had a negative impact on grain quality. Only annual administration of 20 t/ha manure, increased crude protein content (13.12%), but not exceeded the requirements standart (14%). Therefore, when winter wheat fertilization with manure appears urgent need to administrate (foliar) a small doses of nitrogen, to improve grain quality.

Table 1. The influence of anthropic-impact level on soil plasticity

Average annual dose of manure, t/ha	Dose of manure applied in previous culture, t/ha	The average harvest of grain, kg/ha	The yield increase		Content, %	
			kg/ha	%	Crude protein	Crude glutein
Control (without fertilize) 3.3 t / ha	-	1760	-	-	12.41	23.6
6.6 t/ha	20	2240	480	27.2	10.81	20.1
9,9 t/ha	40	2420	660	37.5	11.69	23.0
	60	2580	820	46.6	11.64	21.8
20 t/ha	**20	*3190	1430	81.2	13.12	23.1

\*Average of 5-years experience, direct action of manure

\*\*Manure 20 t/ha applied every year

În the soil with manure fertilization incorporating not only NPK, but and all other nutrients (macro-, micronutrients such as calcium, magnesium, sulfur, iron, manganese, molybdenum, zinc, boron, iodine). If we had fertilize the wheat with manure it is not practical to apply foliar complex fertilizer in the vegetation. They are more expensive compared to the price of urea which provides aproximativly the same effect on the grain quality. Relatively low concentration of nutrients (approx. 13 kg/t NPK) and relatively high dose of manure applied on 1 hectare (10-20 t), leads to increased the transporting costs of manure in the field. To reduce the costs, the manure is applied to land near the farms. Another method of reducing the costs is

composting the manure with phosphorus fertilizer (1-3% by weight). In this case ammonia nitrogen from manure, interacts with phosphorus, forming a stable substance - Amofos or Diamofos. The use of poultry manure, especially in the dry form, reduce the doses approximatly to 5 t / ha. This dose is practically equivalent (after NPK content) with 40t wet manure produced by cattle. In the regions, where it operates poultry plants, poultry manure is a "Divine gift" for all nearby farmers.

Relatively low concentrations of nutrients (about 13 kg NPK to 1t), and the too high volume of manure used per hectare (40-60 t), necessary to find new ways to increase the nutrients concentration and reduction the

application dose of this organic fertilizer. One of these methods is processing livestock waste with California's red earthworms. The obtained product (vermicompost) is administered at a dose 10 times smaller (4-6 t/ha), compared to traditional manure (40-60 t/ha), has a higher content of nutrients. Vermicompost, obtained in different countries from different animal waste is different. For example, vermicompost obtained by E. Miorzlaia G., (2004) in Russia, has the following content of nutrient: 0.6-1.4% N, P 0.4 - 2.7%, K 0.5-1.9%. Vermicompost produced in Germany has a much higher content of nutrients: N – 4%, P – 5%, K – 2.5% (Melzer R., 1988) because, in the processing with earth worms, have been used various additions - bone meal, flour, phosphate, blood meal and doses of incorporation in soil - much smaller. Obtained vermicompost in Moldova contains far fewer nutrients: N - 0.8%, P - 1.4% K - 1.2% (Cremeneac, 2003) and applied doses can't be 4-6 t/ha. So then, the chemical content of vermicompost, obtained from different species of animals, and dosage of administration are less studied in the Republic of Moldova.

Experiments performed with different types of processing manure with Red California's, earthworms demonstrates, that vermicompost nitrogen content decreases slightly, but phosphorus and potassium content increase, as compared with the initial amount (Table 2).

Table 2 Chemical composition of vermicompost, obtained from manure of different animal species in 2007-2010

Moisture,%	Dry matter, %	Natural mass content, % in mass		
		N	P	K
Vermicompost from Cattle manure				
45.1	54.9	0.34	0.51	1.11
Vermicompost from Swine manure				
41.7	58.3	0.59	0.72	0.76

Processing of manure with California red earthworms not significantly increased the content of nutrients, but increased the cost of vermicompost. The data obtained allow us to conclude, that this technology is relatively difficult, with many problems, and the obtained vermicompost is quite expensive. Currently it is not widespread in the country and is't used by many farmers.

## CONCLUSIONS

The Republic of Moldova has not recommendations on the application of organic fertilizer to winter wheat. But the data, obtained in long-term experiments in Moldova and recommendations from neighbors country demonstrate, that for this crop can be used the manure, autumn plowing in dose 20 t/ha. Increase harvest was 1430 kg/ha. When applying manure under forerunner of winter wheat, doses may be increased to 40-60 t/ha. Wheat grain quality is relatively low in the fertilization with manure: the crude gluten and crude protein content in wheat grains were 23.6 and 12.41% respectively. To increase wheat production quality is recommended to apply foliar nitrogen fertilizer, during grain formation. Processing of animal waste with California red worms considerably reduces the volume of organic fertilizers, but not the content of NPK, increase the cost of vermicompost. In Moldova Republic conditions it is not rational to process the manure with California red worms.

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