Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 17, Issue 2, 2017
PRINT ISSN 2284-7995, E-ISSN 2285-3952

STUDIES ON THE USE OF AMMONIUM NITRATE VERSUS UREA, ON WHEAT CROP, IN BURNAS PLATEAU AREA, TELEORMAN COUNTY, ROMANIA

Mihai BERCA[1], Roxana HOROIAŞ[2], Gabriel PĂSCUŢ[2]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania, Email: prof.mihai.berca@gmail.com
[2]AGROVET SA, 20 Siriului Street, District 1, 014354, Bucharest, Romania, Email: roxana.horoias@gmail.com

Corresponding author: prof.mihai.berca@gmail.com

Abstract

To produce one ton of wheat, the crop consumes an amount of 22- 26 kg N, depending on the variety (protein content), but also on the climatic conditions, influencing the assimilation of chlorophyll. In Romania, the nitrogen is commonly applied in two forms: nitrates and urea. Less often, nitrogen solutions are used. For more than 7 years, agricultural practice, looking to increase the efficiency of agricultural nitrogen nutrition, publicly raises the issue regarding the most effective form of nitrogen for the wheat crop and its quality. This subject is also current for the European agriculture. For a long time it has been considered that the difference between the two forms of fertilization, at the same amount of active substance, is insignificant. Recent researches conducted in Europe (France, Germany, England) have statistically demonstrated that nitrogen as nitrate is superior to urea, at the same dose of nitrogen, with about 500 kg wheat/ha and up to 0.7% protein content. At the same time, ammonium nitrate is up to 50% less polluting than urea. Burnas Plain research, carried out during 2014-2016 with two wheat varieties, Arnold and Adesso, with nitrogen doses from 0 to 200 kg/ha, have highlighted the superiority of ammonium nitrate, with increases of 3.1-5.1 q/ha, at higher doses to Arnold variety. The differences in ammonium nitrate favour are smaller for Adesso variety, namely 1.4 q/ha, regardless of dosage. The protein content brought in addition by nitrate is 0.36% for Arnold and 0.56 for Adesso variety. In average for the two varieties, yield gain variation is between 2.25 q/ha (N40) and 3.31 q/ha (N200), while the protein increase brought by nitrate is 0.35% at N40 and 0.47% at N200.

Key words**:** *ammonium nitrate, urea, wheat, yield, protein*

INTRODUCTION

Both forms of fertilizer are coming from ammonia (NH_3), and ammonia comes from the air nitrogen. Ammonia can also be made of methane gas, in which case pollution is greater.

The manufacturing of urea is longer than that of the ammonium nitrate and, therefore, the nitrogen absorption from urea is also longer.

In terms of physical characteristics, Borealis Group determined that the parameters are in ammonium nitrate advantage, which has a higher density (900 kg/m^3) compared to urea (770 kg/m^3). As a consequence, in transversal plane, the coefficient of variation of the fertilizer distribution ranges from 6% for ammonium nitrate and 26% for urea.

From ecological point of view, the EcoX parameter, calculated by Lammel and Brentrup (2003), shows that only ammonium nitrate falls within acceptable limits. The volatilization, for ammonium nitrate in arable land, varies between 3% (DEFRA, 2003-2005) and 0.6% (EMEP, 2007). In case of urea, the volatilization coefficient is very high and ranges between 22% (DEFRA 2003-2005) and 11.5% (after EMEP, 2007).

These unfavourable information to urea have raised the practical problem of its biological effectiveness, compared with other nutrients, such as ammonium nitrate. For this, extremely numerous researches to the main agricultural crops have been made.

On wheat, research carried out in Hanover area in 1999-2002 and published in the German newspaper "Top Agrar" shows that, regardless of the applied nitrogen dose,

ammonium nitrate achieves higher yields compared to urea, but still insignificant.
Other multiannual experiences (ADA, 2015) show differences of 9 and 12 q wheat/ha on ammonium nitrate compared to urea. The dose of nitrogen was 153 kg N/ha in both cases.
If we were to do an overall average of all research conducted in England (Levington Agriculture, 1999; mentioned by Lammel), Germany (ADA, 2015; ADA, 2016) and France (YARA, 2011), we could say that the difference between ammonium nitrate and urea in wheat yield is around 500 kg/ha (about 7%), and the protein of about 0.4% in favour of ammonium nitrate.

MATERIALS AND METHODS

Research has been conducted during the 2014-2015 and 2015-2016 agricultural years, in the experimental field of Agrovet SA – Poroschia, Teleorman County, Romania.
Soil is an easily leached chernozem, degraded, with 3-3.5% humus.
The climate is a forest steppe one, caused by the forests' disappearance. Average annual rainfall: 460 mm.
Those two years were atypical for the wheat crop. 2014-2015 was wet in autumn, making difficult the wheat sowing. It was dry at the end of April and wet again during harvesting.
2015-2016 was quite similar, noting that the alternation of wet and dry periods was more pronounced. Humidity was higher in May-June-July, favouring foliar diseases attack.
Through experiences and verification plots in the field, have been aimed:

- → the ammonium nitrate effectiveness on wheat after rape;
- → the urea effectiveness on wheat after rape;
- → the used doses, expressed in kg/ha, for both nutrients were 0, 40, 80, 120, 160 and 200 kg N / ha, or 6 nutrition levels;
- → the two nutrients that have been used, were: ammonium nitrate 33.5% N and urea 46% N;
- → the experiment has been conducted using two varieties of premium wheat, with protean potential, in order to see how the nutrients may influence this parameter:

(i)Arnold variety, early, genetically made to obtain high percentages of protein;
(ii)Adesso variety, not so early, offering a smaller amount of protein.
Because were installed 2 x 2 x 6 = 24 variants, the research type experience has been organized on a 12 hectares, each variant occupying 0.5 hectares.
Harvesting and sampling were done on five repetitions, using the random survey method, each survey having 10 sqm.
There has been measured the yield level and the protein content, in Probstdorfer Saatzucht Romania SRL laboratory. Data were statistically processed by variance analysis. Correlation calculation was performed in 2D and 3D. In this paper are presented only some of the results.

RESULTS AND DISCUSSIONS

Evaluation of production for varieties, for fertilizers type and dosage are presented by the two years average and only on the yield increase, calculated from level "0". To facilitate interpretation, aren't presented the 3D graphs, but an enlarged version of 2D.
Yield increase. For Arnold, Adesso and their average, the results are shown in Figures 1, 2 and 3, which show the following:

- → yield increases very significantly with increasing doses of nitrogen, but only up to 160 kg N/ha, regardless of its form;
- → at all doses, yield increases were favourable to ammonium nitrate, with differences between 3.1 and 4.5 q/ha;
- → not high doses gave the greatest difference, but the variations within the error limits;
- → the dose of 120 kg N/ha is the one that brings the higher difference between the two forms of fertilizer (5.5 q wheat/ha); it is, in fact, the most common used dose for the wheat crop in Romania.

For Adesso variety (Figure 2), the two curves are much closer, although in all cases the ammonium nitrate yields increases are over those of urea.

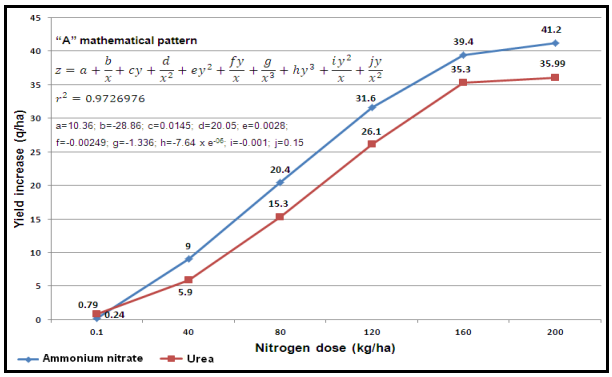

Fig. 1. The influence of wheat variety and dosage of nitrogen fertilizer on yield increase for Arnold variety

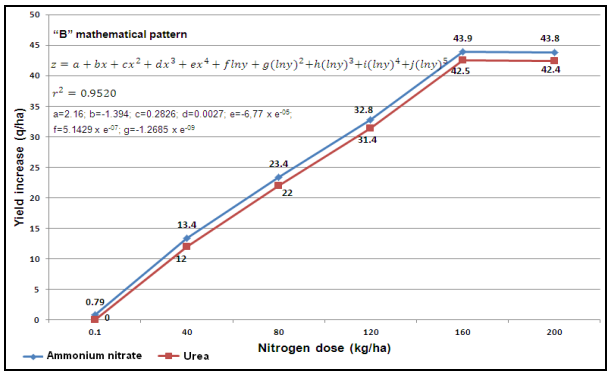

Fig. 2. The influence of wheat variety and dosage of nitrogen fertilizer on yield increase for Adesso variety

The differences, however, are of borderline significance – 1.4 q/ha from the dose of 40 kg N/ha and up to the one of 200 kg N/ha.

In these circumstances, the varieties average (Figure 3), shows significant differences between doses: 2.25 q/ha at 40 kg N/ha → 3.25 q/ha at 80 kg N/ha → 3.45 at 120 kg N/ha, with a significantly yield increase in favour of ammonium nitrate.

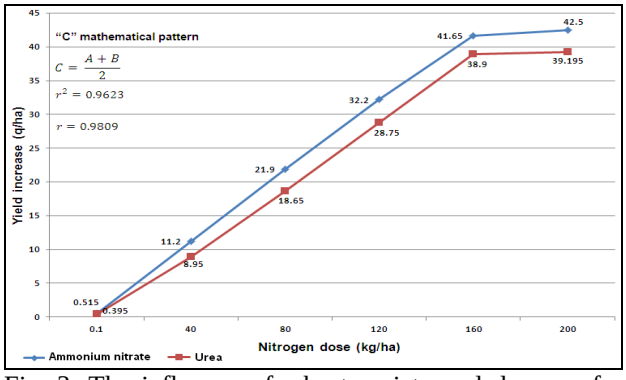

Fig. 3. The influence of wheat variety and dosage of nitrogen fertilizer on the average yield increase for Arnold and Adesso varieties

Conclusion: the statistical analysis of yields increases demonstrate that ammonium nitrate obtained, on average, significant increases for Arnold variety and for the average, but insignificant for Adesso variety.

Requests generated by the higher amount of protein obtained by the Arnold variety can be an explanation for its better reaction towards ammonium nitrate. Figure 4 gives us a synoptic structure of examined factors behaviour.

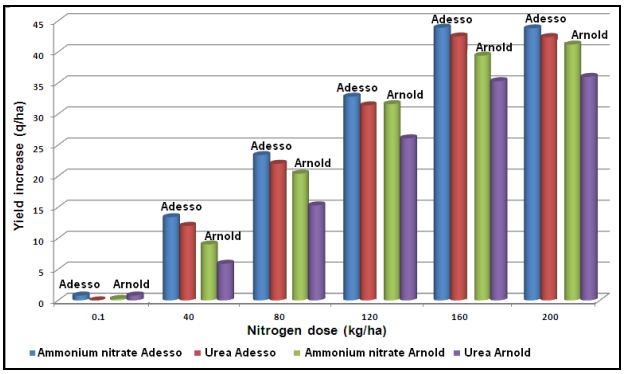

Fig. 4. The influence of nitrogen forms and doses on yield increases, for Arnold and Adesso varieties

Protein content variation. Results are presented in Figures 5, 6, 7 and 8.

For Arnold, ammonium nitrate brings significant protein progress in comparison with urea, increases that correlate with the dose of nitrogen: + 0.3% at 40 kg N/ha → 0.34% at 80 kg N/ha → 0.36% at 120 kg N/ha → 0.38% 160 kg N/ha.

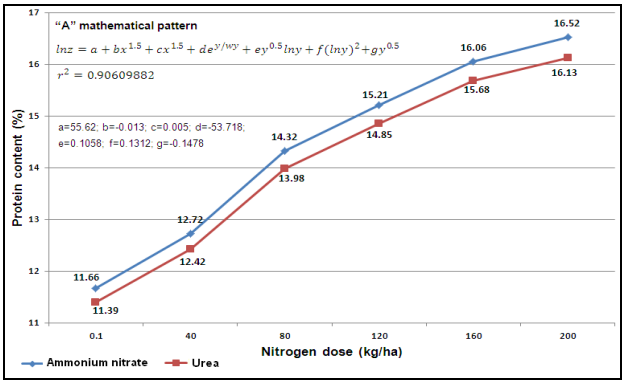

Fig. 5. The influence of wheat variety and dosage of nitrogen fertilizer on protein content for Arnold variety

For Adesso (Figure 6), as opposed to the production, ammonium nitrate brings a significant increase in protein, namely 0.4% at 40 kg N/ha → 0.46% at 80 kg N/ha → 0.51% at 120 kg N/ha → 0.53% at 160 kg N/ha → 0.56% at 200 kg N/ha. Adesso variety has excellently used the ammonium increase the protein content of the wheat grains.

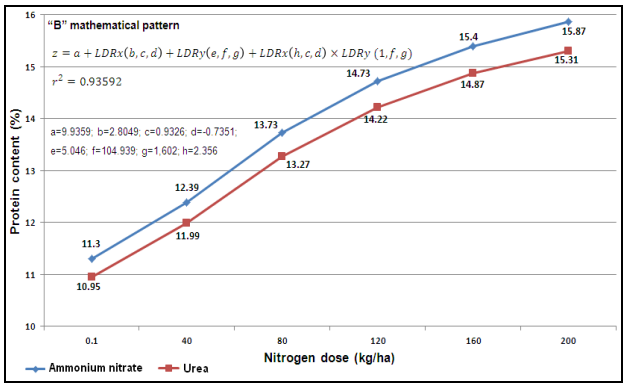

Fig. 6. The influence of wheat variety and dosage of nitrogen fertilizer on protein content for Adesso variety

The average shown in Figure 7, as well as the synoptic chart from Figure 8, further demonstrate that the nitrogen as ammonium nitrate is always superior to urea, concerning the protein content of the two wheat varieties.

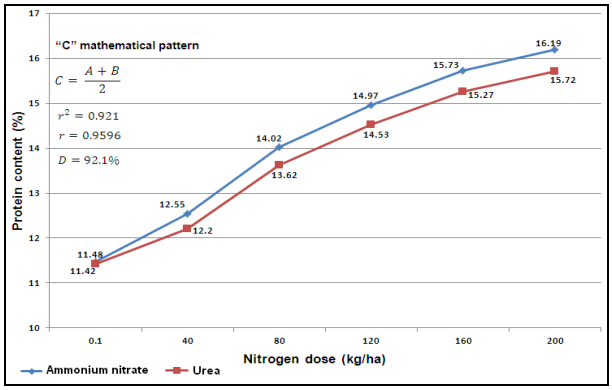

Fig. 7. The influence of wheat variety and dosage of nitrogen fertilizer on the average protein content for Arnold and Adesso varieties

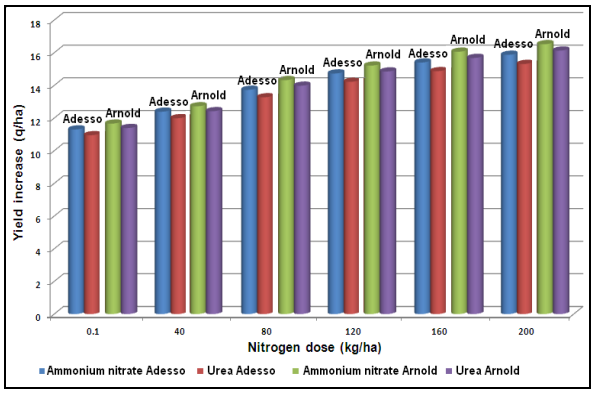

Fig. 8. The influence of nitrogen forms and doses on protein content, for Arnold and Adesso varieties

Most often, these differences relatively small in absolute terms, may go unnoticed at farm level, although farmers were the ones who requested this research.

No matter in which for is nitrogen administrated to plants, it will get to be exploited by them in the form of ammonium (NH_4^+) and nitrate (NO_3^-). Farmers require a nitrogen fertilizer that is immediately absorbed and processed by plants and that is able to provide the expected technical and economic satisfaction.

CONCLUSIONS

Studies conducted in Burnas Plain on the effect of ammonium nitrate and of urea towards the level of yield increases and of protein content in grains, showed that:

(i)Ammonium nitrate is superior to urea, at the same dose applied, achieving to offer higher yield increases.

(ii)The average yield increase is of about 3.5 q/ha. Adesso variety, although it was superior when ammonium nitrate was applied, stays at very short distance of the results obtained with urea.

(iii)For both varieties, the protein content it's very significantly influenced by the ammonium nitrate use, compared to urea.

(iv)It appears that the absorption in plants is by several percent higher for ammonium nitrate than to urea.

REFERENCES

[1]ADA, 2015, Azote et rendement, http://www.azote.info/recoltes-et-azote/azote-et-rendement.html

[2] ADA, 2016, Deux fois moins de pertes d'azote. http://www.azote.info/blog/entry/pertes-par-volatisation.html

[3]Lammel J., Brentrup F., 2003, Environmental assessment of N fertilizer management practices. http://www.ipni.net/ipniweb/portal.nsf/e0f085ed5f091b1b852579000057902e/0f7b758401b3c8bb852573d0000e4500/$FILE/Lammel%202007%20Intl%20N%20Conf%20.pdf.

[4]Lammel J.. Mineral Fertilizer in the Future – Sustainable Farming. Hydro Agri presentation, http://www.arablefarmer.net/uploads/media/mineral_fertil.pdf.

[5]YARA, 2011, Les ammonitrates. Optimiser le rendement, preserver l'environnement. http://www.yara.fr/fertilisation/purs-nutriments/ammonitrates/rendement/.

[6]YARA GmbH & Co. KB, 2011, effizient düngen. Sondernewsletter Dezember 2011, http://www.effizientduengen.de/download/Sonderausgabe_dez_11_web.pdf.