RESEARCH ON THE USE OF URINE AS A SUBSTITUTE FOR AMMONIUM NITROGEN IN THE FERTILIZATION OF A CORN CROP

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Abstract. The present study has started from the idea that the same production can be obtained, fertilizing once with the urea incorporated in the preparation of the germinative bed, as when ammonium nitrate is applied in two passages, in the sowing and in the vegetation. In our study, we analyzed the corn crop response to the two fertilization schemes with 200 kg/ha of urea (96 kg N ha/ha) in the preparation of the germinating bed in parallel with the fertilization in two phases of nitrate ammonium, 150 kg in the preparation of the germinative bed, respectively 125 kg/ha applied after about one month (96 kg/ha to N). Applying this fertilization scheme would allow farmers to reduce the number of crops applied to maize crops and reduce fertilization costs.

Keywords: ammonium nitrogen, fertilization, core crop, climatic conditions.

Rezumat. Cercetări privind utilizarea urinei ca înlocuitor al azotatului de amoniu în fertilizarea unei culturi de porumb. Studiul de față a pornit de la ideea că aceeași producție poate fi obținută, fertilizând odată cu încorporarea ureei în pregătirea patului germinativ, ca atunci când se aplică azotatul de amoniu în două treceri, la semănat și în timpul vegetației. În studiul nostru am analizat o cultură de porumb în două scheme de fertilizare cu 200 kg/ha de uree (96 kg N ha/ha) la pregătirea patului de germinare în paralel cu fertilizarea în două faze de azotat de amoniu, 150 kg la pregătirea patului germinativ, respectiv 125 kg/ha aplicată după aproximativ o lună (96 kg/ha până la N). Aplicarea acestei scheme de fertilizare ar permite agricultorilor să reducă numărul de culturi aplicate culturilor de porumb și să reducă costurile de fertilizare.

Cuvinte cheie: azotat de amoniu, uree, fertilizare, cultura de porumb, condiții climatice.

INTRODUCTION

The present paper aimed to use the two types of nitrogen-based fertilizers (NH_2; NH_4^+), in 2 experimental lots at a corn crop in Apoldul de Jos commune, Sibiu county, in the conditions of 2017, to see the differences of the plants during the evolution, by to the incorporation in the soil before sowing the fertilizers and until the harvesting of the corn sticks. The experience has shown the efficiency of these types of fertilizers that can be used as an alternative to the fertilizers existing on the market, with much lower prices and with a much higher productivity per ha of corn at harvest.

Urea is among the most well-known and used nitrogen fertilizers (N). Expanding the use of this type of fertilizer is based primarily on favorable physico-chemical properties as a synthesis product and then on the qualities of good fertilizer with multiple uses. Urea-type fertilizer has 46% nitrogen (N) s.a., being the most concentrated solid nitrogen solid fertilizer, here the amide form (NH_2), with good evolution in soil, where hydrolysis is supported by ureobacteria (VITOUSEK, 1997, 2000; ZEHR et. al., 2003; UDERT et. al., 2012; NANZER et. al., 2014). In this physico-chemical and microbiological way, the nitrogen stock (N) held is converted into ammoniacal nitrogen (NH_4^+) which is preferred by young plants because it is metabolized with less energy and is not leachable. Under the action of bacteria, ammoniacal nitrogen is transformed into nitric nitrogen (NO_3^-), which is preferred by developed plants (GALLOWAY et. al., 1994; WARD et. al., 2009; ACHAT et. al., 2014).

The two types of nitrogen ($NH4^+$) and ($NO3^-$) in a soluble state have good contact with soil colloids, its solution and the roots of the plants. It is therefore appreciated that urea within the soil had a good evolution, which results in a good use of the fertilizer potential. Also, urea is the lowest cost fertilizer per kg of active substance containing N (PARNES, 1990; CABEZA et. al., 2011).

The results obtained during 2017 have shown the efficiency of these nitrogen-based fertilizers, which can be used by the farmers in Sibiu county dealing with cereal crops. In the future we intend to extend the research to other types of crops to verify the efficiency of these fertilizers. In the current context, when seed herbicides and fertilizers increase each year by an average of 5% and the grain sale price has remained at the same level, farmers have to adopt new technologies to allow them to optimize their investments and grow productivity per unit area.

MATERIALS AND METHOD

The present study was carried out on a 1400m² land located in Apoldu de Jos, Sibiu County. The study consisted of comparing two variants of nitrogen fertilization to corn crops. Both variants yielded 92 kg/ha of the N-active substance, but the form under which the nitrogen was found and the time of application differed. In the first variant, marked with V1, the fertilization was done with 200 kg/ha of urea applied in a single passage of sowing, and the second variant of fertilization, marked with V_2, was applied fractionally 270 kg/ha nitrate ammonium, in two tranches, before sowing and in pigs (Figs. 1, 2). The nitrogen types used in the study were amide URE, and the ammonium nitrate was 50% nitric and 50% ammoniacal.

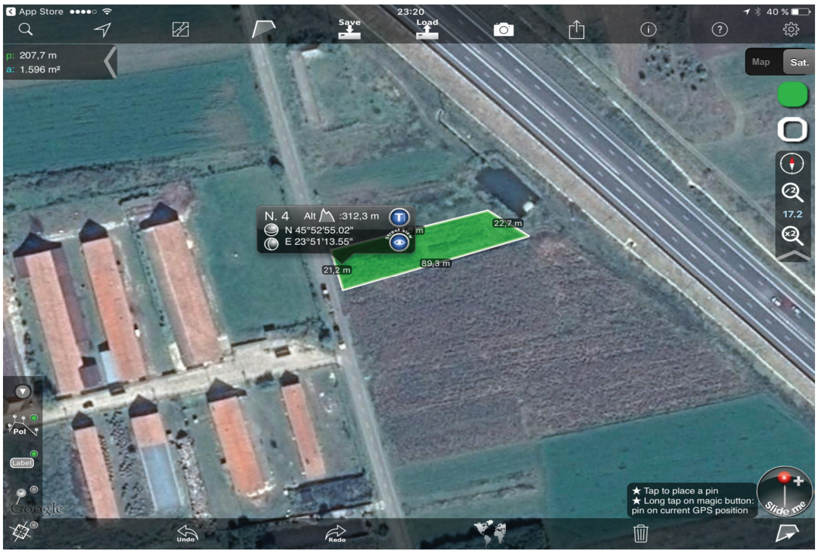

Figure 1. Satellite image with the plot on which the experimental lot was placed (original).

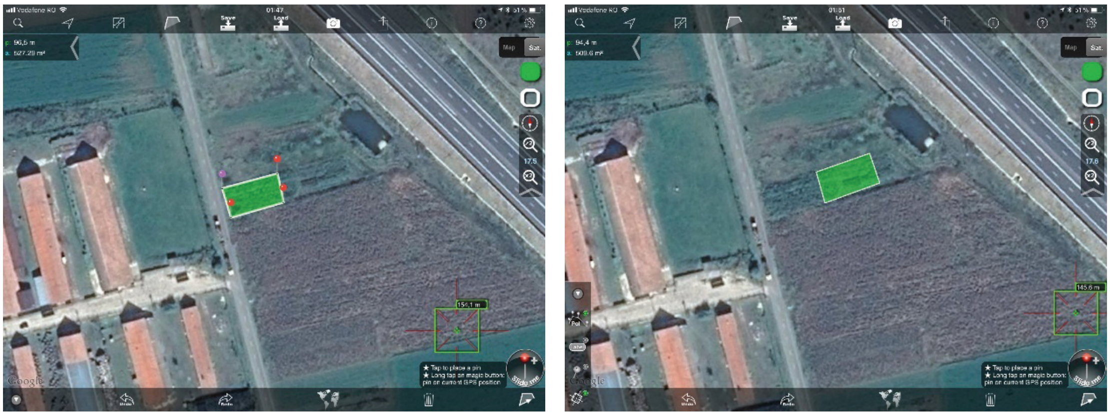

Figure 2. Marking plots V1 = 528 m^2 V2 = 510 m^2

RESULTS AND DISCUSSIONS

The experiment started from the idea of producing at least as large a V_1 fertilization scheme where the maize-cultivated area was 528 m^2 compared to the V_2 fertilization yields on a cultivated 510 m^2 plot, but there was a difference between the lower cost and the lower volume of work for V_1 (Fig. 2). During the vegetation period, soil samples from 0-25 cm and 26-50 cm horizons were also analyzed to determine the amount of N existing at the time of sampling, the mobility of various forms of nitrogen and the availability of N for plants.

For the variant (V_1), with an area of 528 m^2, the land was plowed in autumn 2016 at a depth of 22-25 cm. In the last decade of April 2017, Clinic 360 SL, a total herbicide of Group 4 toxicity at a dose of 5 liters/ha (1800 ml glyphosate/ha) was applied. On April 29, 2017, the first crossing with the disc harrow was made to prepare the germinating bed.

On May 1, 2017, the first soil samples were taken to determine the initial N content, after which the urea was scattered at a dose of 200 kg/ha, and a second drift was made with discs to incorporate the fertilizer. After the superficial incorporation of the fertilizer, the corn hybrid DKC 4943 was sown at a density of 74,000 grains/ha. The distance between the rows is 70 cm and the depth of sowing is 6-7 cm. In the period 01 May-06 June 2017, from the pluviometric measurements performed in the mentioned interval, the volume of precipitation was 58.5 l/m^2.

On June 6, 2017, observations were made on the plants, a second series of soil samples was taken, the crop was slaughtered for the destruction of the weeds. In the period 06-23 June 2017, the volume of precipitation was 42l/m^2.

On June 24, 2017, a third series of soil samples was taken for laboratory analysis to determine the amount of nitrogen. Between June 23 and July 15, 2017, the volume of rainfall was 68 l/m^2.

On July 15, 2017, a fourth series of soil samples was taken for laboratory analysis to determine the amount of nitrogen and observations were made on the crop. Between 15 July and 9 September 2017, the volume of precipitation was 61l/m^2.

On October 17, 2017 maize was harvested.

The 2nd variation (V_2) of the cultivated area was 510 m^2 the land was shown in autumn 2016 at a depth of 22-25 cm. In the last decade of April 2017, Clinic 360 SL, a total herbicide of Group 4 toxicity at a dose of 5 liters/ha (1800 ml glyphosate/ha) was applied. On April 29, 2017, the first crossing with disc harrows was made to prepare the germinating bed (Fig. 3).

On May 1, 2017, the first soil samples were taken to determine the initial N content, after which NH_4; NO_3 was dispensed at a rate of 150 kg/ha, and a second drift was made with disc harrows to incorporate the fertilizer. After the superficial incorporation of the fertilizer, the corn hybrid DKC 4943 was sown at a density of 74,000 grains/ha. The distance between the rows is 70 cm and the depth of sowing is 6-7 cm. In the period 01 May-06 June 2017, from the pluviometric measurements performed in the mentioned interval, the volume of precipitation was 58.5 l/m^2.

On June 6, 2017, observations were made on the plants, a second series of soil samples were taken, and we dispersed the NH4NO3 at a rate of 120 kg/ha, after which the crop was slaughtered for the destruction of the weeds. In the period 06-23 June 2017, the volume of precipitation was 42 l/m^2.

On 24 June 2017 we took the third series of soil samples for laboratory analysis to determine the amount of nitrogen. Between June 23 and July 15, 2017, the volume of rainfall was 68 l/m^2.

On July 15, 2017, a fourth series of soil samples was taken for laboratory analysis to determine the amount of nitrogen and observations were made on the crop. Between 15 July and 9 September 2017, the volume of precipitation was 61 l/ m^2.

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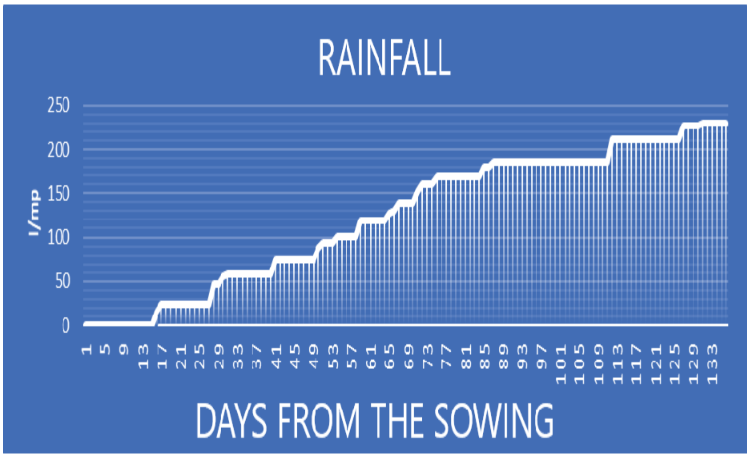

Figure 3. Precipitation during the vegetation period (original).

The first observations on the plants were made on June 6, 2017, before administering the second dose of ammonium nitrate to version V_2. It was found that V_1 fertilized with urea was better developed (Figs. 4, 5).

Figure 4. Stage of development V1 at 6 June 2017 (original).

Figure 5. Stage of development V2 at 6 June 2017 (original).

In the 2nd variant, V_2 is fertilized with ammonium nitrate, the plants were less developed than those fertilized with urea.

Corn plants fertilized with urea in the 8-leaf stage had thicker stems than plants in the fertilized plot of ammonium nitrate. Plants fertilized with ammonium nitrate were visibly less developed, most of them were in the 7-leaf stage and had thinner stems than plants in the urea-fertilized plot. No color differences were observed between plants (Fig. 6).

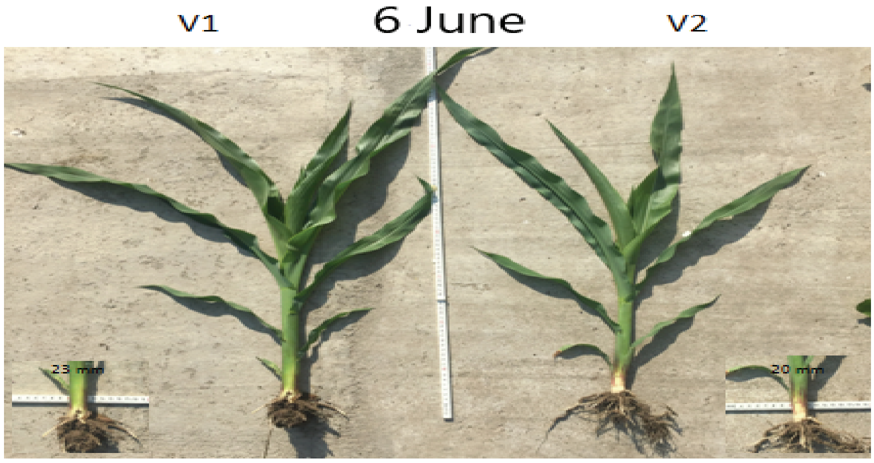

Figure 6. Differences between development stages of V_1 and V_2 at 6 June 2017 (original).

On June 23, 2017, three weeks after the application of the second ammonium nitrate dose to version V_2, the corn plants in the ammonium nitrate fertilizer group recovered and no differences were observed between the plants of the two variants. The plants were in the 12-13 leaf stage and no color differences were observed between the two batches (Fig. 7).

Figure 7. Stage of development V_1 and V_2 at 23 June 2017 (original).

Blooming and stitching began after July 17-18, 2017 and took place at the same time in both variants. Because it was sown later than the nearby corn and the hybrid used was quite late for the area where it was grown (RM 99, FAO 400), corn in the field subject to the experiment reached the wax phase with 2-3 waxes weeks later than maize in most of the parks in the area. Because of this, on the entire plot we had a great degree of damage caused by birds (Fig. 8).

Figure 8. Corn husks attacked by birds (original).

The beans on the corn husks were eaten in various proportions, and for this reason the only indicator of productivity we can see is the number of rows of berries on the scoops. In both cases, the number of rows of grains ranged between 16 and 22, more often 18-20 for both fertilization variants. From this point of view there were no differences between the two variants of fertilization (Fig. 9).

Figure 9. Corn husks from lots of V_1 and V_2 (original).

The two corn varieties in the harvested parcels were harvested on October 17, 2017 and the production was weighed using the weighing trailer. The obtained production exceeded 6800 kg/ha and the production differences between the two variants of fertilization were very low.

At the V_1 variation on the surface of 528 sqm we obtained 364 kg and 6894 kg/ha respectively, and at V_2 on the surface of 510 sqm we obtained 351 kg and 6882 kg/ha respectively.

The main reason for declining production is the small amount of precipitation that fell during the vegetation period. In our area corn needs 300-380 mm rainfall during the vegetation period, of which 260-320 mm in May-July. In 2017 in the area in the area where we experienced, only 180 mm precipitations fell in the mentioned interval.

As a result of the field observations, there was a gap in the development of the palates in the two experimental lots only in the first vegetation phases. On June 6, 2017, after 28-29 days of emergence, urea-fertilized plants (V_1) were better developed than fertilized plants with ammonium nitrate (V_2). To date, 92 kg/ha of active nitrogen and 50 kg/ha of active nitrogen for V_2 were applied to V_1.

On 23 June 2017, 17 days after the application of the second 42 kg/ha active nitrogen phase to V_2, the plants in this batch recovered and no differences between V_1 and V_2 were observed. At this time, both batches received a contribution of 92 kg/ha of active nitrogen.

The yields were very close, the difference being 0.17%, 12 kg/ha more at V_1. From an economic point of view, the cost for fertilization with 92 kg/ha b.c. N, from URE to V_1 was 430.5 lei/ha and the production was 6.894 tons/ha.

CONCLUSIONS

In conclusion, under the present study for maize culture, the application of urea in one pass was more agronomically and economically efficient than ammonium nitrate phase fertilization. We also found a positive correlation between the level of fertilization, the values of vegetation indices and the stage of plant development, at the moments when the determinations were made.

Another advantage of applying one-pass urea is to reduce the number of plant passes on the parcel, which brings farmers the following benefits: lower spending, resulting from reduced work and optimization of the technological process.

From an economic point of view, it can be concluded that, expenses for nitrogen fertilization were 62.45 lei for one ton of grain obtained. At V_2, the cost of 92 kg/ha a.a. N from NH_4, NO_3 was 553.4 lei/ha, at a production of 6.882 ton/ha. In this case, the nitrogen fertilization expense was 80.41 lei for one ton of grain obtained.

The cost of nitrogen fertilization for one ton of grain obtained was 28.7% higher for variant V_2, fertilized with ammonium nitrate, which will be to the advantage of the farmers from Sibiu county, who use these types of fertilizers.

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Received: April 15, 2019
Accepted: July 01, 2019