The Reaction of some Winter Wheat Variety at Cultivation in the Conservative System in the Transylvanian Plain Area

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ABSTRACT

Wheat is one of the most important cultivated plants, with great nutritional weight. The wide surfaces on which it is seeded, as well as people's concern regarding the wheat cultivation, are due to certain factors: the high level of the grains in carbon hydrates and proteins; the long conservation of the grains; the big ecological plasticity, being cultivated in areas with very different climates and soils; the possibility of integral mechanization of the crop etc.. Through the experiment done at SCDA Turda, we are following the behaviour of certain inland autumn wheat varieties, in comparison to varieties of foreign origin, in order to make certain recommendations regarding their pretability to various soil tillage systems and levels of fertilization in the region of the Transylvanian Plain.

Keywords: *climatic conditions, conservative system, quality, wheat, yield.*

INTRODUCTION

In Europe, among the countries cultivating wheat, Romania holds the fifth place with a surface of 2,07 million hectares and a yield of 7,45 million tons (Fig. 1). The level of productiveness is also lower when it comes to the registered yield, namely only 3601 kg/ha (www.ager.press.ro).

Out of the total yield of Romania, which in 2014 was of 7,6 million tons, 4 million tons were destined to export (52.6%). The average wheat yield obtained at SCDA Turda between 2008-2010 was of 4036 kg/ha in the classic soil tillage system, whereas in the "no tillage" system of 4378 kg/ha (Chețan *et al.*, 2011).

The introduction of the nonconventional soil tillage systems is necessary for dealing with the negative consequences of soil degradation, with the risk factors on the agricultural ecosystem,

the reduction of costs aiming at the growth of the economic efficiency and the increase of the crop. The progress registered in the domain of mechanization enable the supporting and application of these beneficial tillage systems both for agricultural producers and for the environment, especially if we take into account the climate changes that generate global warming. Through the stubble crop, the vegetal remains from the previous crop protect the soil against surface erosion, while also eliminating the possibility of its compaction (Rusu and Guș, 2007).

The new agricultural system (no tillage) through the stubble cropping gains every year bigger and bigger surfaces. For the year 2000 this system was used for the cultivation of around 60 million hectares, meaning 1.2% of the overall surface of the land (Berca, 2011), and the data of

Fig. 1. Wheat - surface in Europe countries (mil. ha)

the literature in the domain indicate a growth in the cultivated surfaces in the no-tillage system of around 95 million hectares in 2008 (Derpsch, 2008).

The diversity of soil varieties in Romania renders possible the practice of nonconventional soil tillage systems over 42% of the total plough land surface, 15% under favorable conditions and 27% under moderately favorable conditions, states Carnache in 1986.

One of the most important technological factors applied to which grain crops react very well is the application of fertilizers, especially nitrogen (Mărghitaș and Rusu, 2003). Nitrogen is the most important element for the nutrition of plants that is part of all the essential and non-essential aminoacids (Ceapoiu, 1984) being the main constituent of the proteins in the wheat (prolamins, gluten, albumens and globulins).

Ștefănescu and Tianu have reached the conclusion that fertilization on the argillo illuvial chernozem contributes to the growth of the protein content in wheat with 4-6 %, reaching the value of 17.3 depending on the pedoclimatic conditions. The content of wet gluten progressively increases along with the doze of nitrogen, the highest values being obtained with the dozes of 120-160 kg nitrogen/ha and 80 kg phosphorus/ha. The wet gluten reached the highest values with the maximum dozes of nitrogen applied (120 kg/ha after soybean, 160 kg/ha after maize).

In order to prevent the leaching of the nitrogen during the first part of the vegetation, it is desirable that the high dozes of fertilizers be applied on the well-finished crops, in full

vegetation. The application in fractional dozes enables the establishment of the nitrogen doze depending on the condition of the crop and on the climate conditions. The usage percentage of nitrogen in fertilizers increases when it is applied later on during vegetation.

Although wheat has a low consumption of nutritive elements, it is demanding to fertilization because of the radicular system which is poorly developed and the weak leaching power of nutrients in the soil. During autumn the high consumption of nutritive substances is determined by the formation of the radicular mechanism, the tillering of the plants and the accumulation of the necessary supplies over the winter. Early in spring, in the soil there can be found soluble elements in low quantities because of a weak mineralisation of organic substance, and the autumn wheat must find the necessary quantity of nutrients to start vegetation. The first vegetation applied along with the seeding ensures the appropriate thickness of the plants at emergence and favorably influences the vegetation start of the crop.

An insufficient quantity of nutritive elements existing in the soil at the beginning of winter reflects upon the whole period of wheat vegetation, which eventually leads to poor yield.

MATERIAL AND METHOD

The research took place over the period of time 2014-2015, at SCDA Turda, situated in the Transylvanian Plain. The experiment was done on an argic chernozem, with pH ranging between 6.81-7.06; humus between 3.73-2.86%; total nitrogen between 0.205-0.157 ppm; potassium

between 320-220 ppm, values determined on a width of 0-40 cm (OSPA Cluj). Characteristic of this type of soil is typing fast, when passing with of heavy aggregates on surface or where the tillage is carried out under conditions of high humidity.

The experiment done is of polifactorial type, organized according to the method of the subdivided lots, the surface of an experimental lot being of 48 m².

The experiment included the factors:

Factor (A) the system of soil work: 2 graduation: a_1 - conventional (CS) with ploughing (at 30 cm depth) - preparation of the soil - seeding + fertilizing; a_2 - conservative, no tillage (NT) - direct sowing.

Factor (B) the variety: b_1 , Andrada; b_2 , Dumbrava; b_3 , Arieşan; b_4 , T-29-04; b_5 , Renan; b_6 , Apache; b_7 , Exotic; b_8 , Capo.

Factor (C) fertilizing: 4 graduation: - c_1 , the main fertilization 250 kg/ha NPK 20: 20:0; c_2 , the main fertilization 250 kg/ha NPK 20: 20:0 + 214 kg/ha nitro-calcar (NH_4NO_3 + dolomite) at the recovery of vegetation in spring; c_3 , the main fertilization 250 kg/ha NPK 20:20:0 + 100 kg/ha ammonium nitrogen (NH_4NO_3) at the recovery of vegetation + 100 kg/ha ammonium nitrogen at culm elongation stage; c_4 , the main fertilization 250 kg/ha NPK 20:20:0 + 75 kg urea ($\text{NH}_2)_2\text{CO}$ at the end tillering stage + 75 kg/ha urea before heading stage.

The sowing was done with precision seeder Gaspardo - Direct 400 (sowing concomitant with fertilizing, thus avoiding repeated passages with

heavy units on the soil surface), to 18 cm spacing between rows, the depth of incorporation of seed 5 cm and the seed used was treated with the insecto-fungicide Yunta Quatro 1.61 l/seed ton.

The fertilization was done with the machine for administering fertilizers Gaspardo Zeno.

For culture maintenance free weeds, diseases and pest, was executed two complex treatments administered with MET 1500 sprayer, consisting of herbicides, fungicides and insecticides (e.g. Sekator Progres OD 0.15 l/ha + DMA6 0.6 l/ha + Falcon 460 0.7 l/ha + Fastac 0.1 l/ha + adjuvant Trend 0.25 l/ha applied at the at the end tillering and the second treatment with Evolus 1.0 l/ha + Calypso 0.1 l/ha + Trend 0.25 l/ha at before heading). For each treatment were applied 3 kg/ha of foliar fertilizer Polyfeed (NPK 19:19:19 + ME).

The crop was harvested with a Wintersteiger combine, when the moisture content of the wheat was 15 per cent or less.

The weather conditions in the years 2104-2015 (The Weather Station in Turda, longitude: 23° 47'; latitude 46°35'; altitude 427 m) are presented in Fig. 2 and Fig. 3.

As seen in Fig. 2, over the last 13 years the average monthly values of temperatures are higher as compared to the average of the last 59 years. From the thermic point of view, having the annual average value of 11,1°C, the year 2014 is characterised as being the hottest of the last 59 years (the average multiannual temperature is of 9.1°C). The year 2015 was a hot year with the

Fig. 2. The thermal regime ARDS Turda, 2014-2015

Fig. 3. The rainfall regime ARDS Turda, 2014-2015

average annual temperature of 10,7°C.

From the point of view of the pluviometric regime (Fig. 3), the year 2014 was rainy, as only four months were normal from the pluviometric perspective (May-August). The rainfall was low during the first half of the year 2015, whereas the second half of the year was to be rainy, the highest values of rainfall being registered in the month of September (172.5 mm).

The wheat suffered from the drought installed during spring, but the rain that came along in the month of June (115 mm) succeeded in re-establishing the water supply in the soil, which led to the attainment of a good yield.

RESULTS AND DISCUSSIONS

The reaction of grain crops to the application of various technological measures and not only is known to be a positive one; the determination of the main qualitative parameters (gluten, protein) seeks for the response of the wheat plants in the experiment in rendering the values of these parameters as compared to the technological factors applied.

From among the 8 autumn wheat varieties included in the experiment (figure 4) the austrian soil variety Capo stands out, as it registered the highest values of gluten content at the fertilization levels c_2 (250 kg/ha NPK 20: 20:0 + 214 kg/ha nitro-calcar), c_3 (250 kg/ha NPK 20:20:0 + 100 kg/ha ammonium nitrogen + 100 kg/ha ammonium nitrogen) and c_4 (250 kg/ha NPK 20:20:0 + 75 kg urea + 75 kg/ha urea) at cropping in both soil

tillage systems (CS and NT). The biggest influence upon the gluten content seems to be at the fertilization level c_2 (250 kg/ha NPK 20: 20:0 + 214 kg/ha nitro-calcar).

With the majority of varieties, the gluten content (%) at the level of fertilization c_2 registers higher values, except for the varieties Exotic (KWS) and Capo, which best react to the fertilization level c_3 (250 kg/ha NPK 20:20:0 + 100 kg/ha ammonium nitrogen + 100 kg/ha ammonium nitrogen) in the NT system.

All varieties attained a content of gluten below the average values in the two soil tillage systems (22.88% in the CS and 22.04% in the NT system) for the c_1 fertilization variant (the basic fertilization at seeding with 250 kg/ha NPK 20: 20:0).

From what has been mentioned above we can conclude that the Romanian autumn wheat Andrada, Dumbrava, Arieșan and the line T-29-04, as well as the Renan (Limagrain) best react in terms of gluten content at the c_2 level of fertilization (the basic fertilization 250 kg/ha NPK 20: 20:0 + 214 kg/ha nitro-calcar (NH_4NO_3) at the recovery of vegetation in spring) in both soil tillage systems.

The Capo soil variety which is part of the group of grains of premium type will obviously require higher quantities of fertilizers in order to ensure a superior quality.

It is well-known the direct relation between the gluten content and that of proteins, which can be also noticed in Fig. 5, so that in the majority of cases the highest content of protein is obtained at the c_2 level of fertilization (250 kg/ha NPK

Fig. 4. The influence of level fertilization on gluten content (%)

20: 20:0 + 214 kg/ha nitro-calcar) except for the varieties Exotic and Capo which best react in terms of this feature in the NT system at the c₃ level of fertilization (250 kg/ha NPK 20:20:0 + 100 kg/ha ammonium nitrogen + 100 kg/ha ammonium nitrogen).

The Dumbrava variety registers the lowest content of proteins as compared to the average in the two soil tillage systems (CS, NT).

The Capo variety confirms its quality at the levels of fertilization c₂, c₃, c₄ while at the level of fertilization c₁ it behaves similarly to the other experimented varieties.

Table 1 presents the significantly negative distinct influence of the system factor upon the

wheat yield.

The yield difference between the two soil tillage systems is of 712 kg/ha in favor of the classic system. In exchange, it can be noticed the significantly positive influence of the supplementary fertilization technology upon the grains yield, the difference as compared to the witness variant (the basic fertilization with 250 kg/ha NPK 20:20:0) ranging between 659-712 kg/ha.

Due to the radicular system poorly developed, the wheat fertilization must be done in appropriate doses and in a fractional manner in order to ensure for the plants the necessary fertilizers over a period of time as long as possible.

According to the literature in the domain,

Fig. 5. The influence of level fertilization on protein content (%)

Tab. 1. The influence of experimental factors on yield realised, 2015

The factor	Yield (kg/ha) 14% H	%	Differences
a ₁ - classic system	7452 ^{Mt}	100,0	0,00
a ₂ - "no tillage" system	7284 ⁰⁰	97,8	-167,48
DL (p 5%) 26; DL (p 1%) 130; DL (p 0,1%) 503.			
c ₁ -250 kg/ha NPK 20: 20:0	6859 ^{Mt}	100,0	0,00
c ₂ -250 kg/ha NPK 20: 20:0 + 214 kg/ha nitro-calcar	7523 ^{***}	109,7	664,69
c ₃ -250 kg/ha NPK 20:20:0 + 100 kg/ha ammonium nitrate + 100 kg/ha ammonium nitrate	7571 ^{***}	110,4	712,44
c ₄ -250 kg/ha NPK 20:20:0 +75 kg urea + 75 kg/ha urea	7518 ^{***}	109,6	659,16
DL (p 5%) 26; DL (p 1%) 34; DL (p 0,1%) 45.			
b ₁ - Andrada	7181 ^{Mt}	100,0	0,00
b ₂ - Dumbrava	7175 ⁻	99,9	-6,44
b ₃ - Ariesan	7439 ^{***}	103,6	258,38
b ₄ -T-29-04	7430 ^{***}	103,5	249,19
b ₅ - Renan	7193 ⁻	100,2	11,50
b ₆ - Apache	7913 ^{***}	110,2	731,81
b ₇ - Exotic	7461 ^{***}	103,9	279,75
b ₈ - Capo	7152 ⁻	99,6	-29,38
DL (p 5%) 46; DL (p 1%) 64; DL (p 0,1%) 98.			

the application of nitrogen on to an optimum phosphorus background is of major importance: in autumn, in the formation of the radicular system, the accumulation of supply substances; early in spring, at the recovery of vegetation, as the soil contains few soluble elements, so that the mineralization of the organic substance is poor, the nitrates are leigated into the soil by the precipitations during the winter and find themselves in the access area of wheat roots; the period of maximum consumption of nutrients for wheat takes place in the span of time ranging between earing and maturation, so it is advisable to apply a last fertilization based on nitrogen in this phase.

In the present case, the fertilization variant c₃ (250 kg/ha NPK 20:20:0 at seeding + 100 kg/ha ammonium nitrogen at the recovery of vegetation + 100 kg/ha ammonium nitrogen at bellows) led to the attainment of a yield of 7571 kg/ha followed by variant c₂ (250 kg/ha NPK 20: 20:0 at seeding + 214 kg/ha nitro-calcar at the recovery of vegetation) and c₄ (250 kg/ha NPK 20:20:0 at seeding + 75 kg urea at the recovery of vegetation + 75 kg/ha urea at stripping).

The average yields registered for the eight varieties of wheat had values of over 7000 kg/ha; however, we can notice the significantly positive influence of the Apache (7913 kg/ha), Exotic (7641 kg/ha), Ariesan (7439 kg/ha) and line

T-29-04 (7430 kg/ha), as compared to the witness Andrada (7181 kg/ha), the differences ranging between 249-731 kg/ha.

The varieties Capo, Dumbrava and Renan influenced the yield in a significantly negative way through the values of 7152, 7175 namely 7193 kg/ha, even if the differences are rather small (6-29 kg/ha).

CONCLUSIONS

The Ariesan variety, despite being the "oldest" variety, attained a content of protein of 13.5 % and 27.10 % gluten in the classic system at the variant with two fertilizations;

The Capo variety attained the highest content of protein of 14.2 % and 28.55 % gluten in the "no tillage" system at the variant with three fertilizations;

The Dumbrava variety is more demanding in terms of fertilization, the lowest value of protein being of 9.5% and was attained at the basic fertilization variant in the classic system, and 8.6 % in the "no tillage" system, while the gluten content reached values of 18.0 % in the classic system and 16.05 % in the "no tillage" system;

The data regarding the yield registered for the eight autumn wheat varieties in the experiment (over 7000 kg/ha) indicate the pretability of cropping in the "no tillage" system with fractional fertilization: in autumn at seeding, at the recovery

of vegetation in spring, at stripping.

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