ABSTRACT

Key words: wheat, fertilization, weed control, production, quality

Wheat is one of the oldest cultivated plants, being used as ”the daily bread” by over half of the world’s population. It has the most favorable ratio between the carbohydrates and proteins, of 6:1. It is also used in industry, for starch or dextrin’s extraction, alcohol production or for animal food, being very important from the agricultural technique’s perspective. After wheat harvesting, many other successive cultures are fit to be settled (maize, soy, sunflower).

Wheat occupies the widest cultivated surface on the planet, of 216 millions hectares in 2007, with a production of 2898 kg/ha and a total of 626 millions tones.

In Romania, in the last five years, wheat was cultivated on a surface varying between 2.012 millions hectares in 2006 and 2.47 millions in 2005 and an average production of 2375 kg/ha in 2005 and 3403 kg/ha in 2004. In 2007, the average production was of 1504.9 kg/ha.

The importance of the wheat, as well as its spreading in over 100 of the world’s countries determined numerous studies in time and all over the world. About its biology and technology exists today a wide bibliography, valuable and useful. In this thesis, only the last three decades’ researches are presented, seldom citing older and basic materials, which can’t be ignored. Also, we limited ourselves to studies which cope with the problems that we approached in the thesis, which are fertilization and weed control, their effect on production and bread wheat’s quality.

The experiments took place in Garvan in Tulcea county, on an alluvial soil with : 0,23% total nitrogen; 24,60 ppm mobile P ; 240 ppm mobile K ; pH 7,9 and 3,6 % humus in the 0-17 cm soil layer, without irrigation.

The climate conditions in the five years of experimentation were favorable to autumn wheat, excepting the agricultural year 2002-2003, when spring’s high temperatures, even if the humidity was sufficient, determined less favorable conditions which reflected in diminished productions, because of some very active pathogenic agents.

In the agricultural years 2001-2002, 2003-2004, 2004-2005 and 2005-2006 the obtained productions were high, the years being favorable from the climate conditions’ point of view.

Our researches goal was to improve the autumn wheat cultivation technology, for a quantitative and qualitative increase of caryopses production into the limits of economical efficiency and protecting the environment.

The main proposed objectives were:

- quantifying the effect of the nitrogen and phosphorus fertilizers on the caryopses production for the autumn wheat;
- establishing the influence of the fertilizers on the protein content, humid gluten content and on other quality indicators;
- the effect of the ecological conditions on the production and its quality;
- weed chemical control from the wheat culture with simple or mixed herbicides;
- the effect of weed control on the baking quality of the wheat;
- the economical efficiency and the obtained results;

In order to accomplish all these items we organized 2 field experiments and we made laboratory analyses regarding the protein content, the humid and dry gluten content.

The first experiment, with two variation factors, included:

Factor phosphorus fertilization, with five degrees: a_1-P_0 ; a_2-P_{40} ; a_3-P_{80} ; a_4-P_{120} ; a_5-P_{160}.

Factor B – nitrogen fertilization, with five degrees: b_1-N_0 ; b_2-N_{40} ; b_3-N_{80}(40+40) ; b_4-N_{120} (40+40+40); b_5-N_{160} (40+80+40).

The second experiment, with simple and mixed herbicides, had the following variants:

var.1 -SDMA 33, 2 l/ha; **var.2**-DMA 6, 1 l/ha; **var.3**- Icedin forte, 2 l/ha; **var.4**- Icedin super, 1 l/ha; **var.5**- Oltisan extra, 1 l/ha; **var.6**- Lontrel 418, 5 kg/ha; **var.7**- Basagran, 3 l/ha; **var.8** - Buctril M, 1 l/ha; **var.9** - Grodyl, 0,020 kg/ha; **var.10** - Glean 75, 0,015 kg/ha; **var.11** - Glean + Icedin forte, 0,010 kg/ha +2 l/ha; var.12-Sansac, 1 l/ha; **var.13** - Granstar, 0,020 kg/ha; **var.14** - Starane, 0,80 l/ha; **var.15** - Starane + SDMA 600, 0,600 l/ha + 1 l /ha**; var.16** – untreated control.

In the experiments, we used the technology applied in farms, with the protocol specifications for each type of experiment. The fertilization experiment had four repetitions, and the herbicides' one, three repetitions.

The physical, chemical and biochemical analyses related to the actual norms, and the statistic calculus respected the variance analysis method.

Analyzing the experiments' results, as average value for five years (2001-2006), the number of risen plants for 1 m^2 was of 537, different from one year to another, the smallest in 2002 (518 pl./m^2) and the biggest in 2005 (557 pl./m^2). Compared to the number of seeded grains able to germinate, the average rising percentage was of 89,5%, varying between 86,3% (2002) and 92,8% (2005), depending on the climate conditions in each year.

In normal or humid autumn years, nitrogen fertilizers influenced more the wheat rising than the phosphorus ones, that didn't have significant effects in two years, while the nitrogen ones, in doses of N_{40} and N_{80} had favorable effects in all years.

As average value for five years, the nitrogen had the best effect in N_{80} dose, and the phosphor in P_{160} dose, but the mixture that determined the best rising percentage was N_{80} P_{160}.

The number of ears for 1 m^2 generally related positive to the number of risen plants, but depended also of other factors, including climate factors and was more influenced by the fertilizers than by the number of risen plants, the last one influencing the unification process.

The number of ears for m^2 which was influenced by the big doses of phosphorus mixed with doses of nitrogen between N_{80}-N_{160} had the most pronounced effect, and positively and distinct significantly related to the caryopses production, compared to all mixtures NxP as average value on five years, being an essential production component for wheat.

As average value for five years, the nitrogen fertilizers increased the number of caryopses in one ear up to 36% (N_{120} and N_{160}), the phosphorus ones with values up to 5% (P_{80}), and their most favorable mixture proved to be $N_{120}P_{80}$, that registered values with 48% more caryopses in one ear compared to the control variant, due to a bigger number of fertile flowers.

The mass of the caryopses in one ear suffered a much bigger influence than their number, due to the fertilizers, especially the nitrogen ones, which brought an increase of 42%, raising the dose up to N_{120} compared to only 36%, for the same dose, in the case of the grain number in one ear registering the positive effect of the fertilizers on wheat.

In the ecological experimentation conditions, the productions annual average level varied from 4025 kg/ha to 6341 kg/ha, and the difference between extreme years reached 2316 kg/ha, being with 599 kg/ha bigger compared to the control, thus the nitrogen and phosphorus fertilization generally equalizes the annual variations of the production and influence negatively its stability in time, but increase substantially their level (with over 2000 kg/ha (in three of five years).

As average value for five experimental years, for nitrogen doses of 120 and 160 kg/ha d.m. we obtained productions of over 6 t/ha, increases of 55 and 58 % (over 1200 kg/ha) and of 14,1-17,9 kg caryopses for one kg active substance fertilizer, which proves the irrefutable effect of nitrogen fertilizers in increasing wheat production.

The phosphorus fertilizers had an effect four times smaller than the nitrogen ones, realizing, at maximum dose (P_{160}), an increase of 529 kg/ha (10%) compared to the control (3,3 kg caryopses for 1 kg active substance fertilizer), and the increase of the phosphorus dose over 80 kg/ha d.m. is not justifiable. This fact relates also with the soil's content in mobile phosphorus.

The mixture N x P had a very significant positive effect, the two elements stimulating their effect one to each other, no matter the combined doses. The mixture $N_{120}P_{80}$, with a production of 6200 kg/ha (as average for five years), with an increase of 73% compared to N_0P_0 and with 13,1 kg caryopses for 1 kg active substance fertilizer, with the smallest difference between extreme years, can be considered the best fertilization variant. This variant is followed by $N_{120}P_{120}$ and $N_{160}P_{80}$. From here results the necessity of applying nitrogen and phosphorus together.

The economical and financial conditions weren't very favorable for valuing the culture, the technological costs raising from one year to another, with a very big leap in the agricultural year 2001-2002, while the delivery price reached 0,6 lei/kg only in one year.

The nitrogen fertilizers tend to diminish the production costs along with the increase of the dose up to 120 kg/ha a.s., starting to grow for bigger doses, in all five years, while the phosphorus fertilizers increase constantly the production costs with the increase of the dose.

As average value for five experimental years, the list of the mixtures with the best productions and economical results were: 1. $N_{120}P_{80}$; 2. $N_{80}P_{80}$; 3. $N_{160}P_{80}$; 4.$N_{120}P_{40}$; 5. $N_{160}P_{40}$. The appropriate mixtures between nitrogen and phosphorus determine also a better quality.

The analyzed qualitative parameters for the caryopses and the wheat flour (MMB, MH, protein content, dry and humid gluten content and protein production) suffered important changes in different directions and quantum, under the influence of the climate conditions of the year and of the nitrogen and phosphorus fertilizers applied alone or as mixture.

As average value for five years MMB registered the biggest values (44,1 g) at $N_{120}P_{160}$, $N_{160}P_{120}$ and $N_{160}P_{160}$ variants.

Nitrogen had the most favorable effect on MH, especially the N_{120} and N_{160} doses, but also N_{80} had a very good value (over 78 kg/hl, while the N_0 and N_{40} variants gave only good average values for MH as average value for five years).

MH positively and distinct significantly correlated to the protein content.

The protein content of the caryopses varied widely with the interaction of the climate factors (different) and the doses of N and P and their combinations, from unsatisfying values (9,2% or close values) in a very moist year and without fertilization, to 18,68% in a dry year with the biggest fertilizers doses ($N_{160}P_{160}$).

No matter the applied fertilization, the protein content of the caryopses had the biggest values in 2003, a drier year, from 11,43% to 18,68%. The increase of the nitrogen dose from N_0 to N_{160} contributed with 5,4 % to this difference, the increase of the phosphorus dose with 1,2 %, and their interaction with 0,7 %. The smallest values for the protein content registered in 2005, a moist year, in which the maximum value of 14,4% protein was obtained for the biggest fertilization doses ($N_{160}P_{160}$), the increase of the

nitrogen and phosphorus doses having a smaller effect. Our results confirm other researches made in Romania.

Very good values for the protein percentage (over 13%) were obtained in all five years, starting with the $N_{120}P_{80}$ dose, confirming once again the nitrogen effect.

Systematizing the factors that induce fluctuations of the protein content of the wheat caryopses, the climate conditions of the year are on the first place, the big doses of nitrogen on the second and the phosphorus on the third, in big doses on a high nitrogen level background or in moderate doses on a low nitrogen level background.

The baking quality of the wheat depends on the protein content of the caryopses, which related positively and very significantly to the humid and dry gluten contents, in the dry years as well as in the moist ones, but also to MH, which related positively to the gluten content, distinct significantly in a moist year, significantly in a dry year and distinct significantly as average on the five years.

The relation between the gluten content (humid and dry) and the nitrogen dose was positive and distinct significant in both years (tighter in the dry year 2003).

The $N_{120}P_{120}$ variant emphasized in what regards the humid and dry gluten contents, as ell as in its stability (in dry and moist years). For the baking process, we are interested in the combinations with the highest content in humid gluten, but also in its stability, because the humid gluten reflects also the quality of the gluten's proteins, their better hydrating capacity during dough making, which leads to a high quality bread.

In the second experiment we observed of some simple or mixed herbicides on the weed degree and wheat caryopses production.

In the conditions of Văcărenilor Plain, the wheat cultures are invaded by a very rich and various segetal flora, identifying a number of 45 species from 24 botanical families, some of them being represented by more genders and species.

Annual and perenne dicotyledonous weeds prevail in the area, monocotyledonous ones having less species but with a more negative influence on the production.

The high degree of weeds is sustained by the weed reserve of the soil, in which we were able to identify 23 genders, some of them with many species; we found in soil seeds of some species we couldn't identify in the crop field, but which can reach in other soil lots.

Fighting against weeds with the help of herbicides is a requirement on short, medium and long term; there are older or newer herbicides capable to reduce the weed degree down to 32-37%, even down to zero, as our researches proved.

The herbicides' effects on weeds, as well as on wheat production depended more or less on the climate conditions of the year.

From the herbicides with fluctuant effects in controlling the weeds we mention: SDMA-33, DMA-6, Oltisan extra, Buctril-M, Grodyl-75 WG, and from the ones with more stable effects: Sansac, Granstar-75 DF, Starane-250 EC (also associated with SDMA-33), Glean-75 DF, Lontrel-418, Basagran; the farmers have the possibility to choose.

As average values on three climatic different years, the most effective herbicides, in what regards the weed control, proved to be:

1. Sansac (2,4 D + metosulan)- 1 l/ha;
2. Starane 250 EC + SDMA-33 (fluroxypyr + 2,4 D)-0,6 + 1 l/ha;
3. Icedin super (2,4 D + Dicamba)- 0,8 l/ha;
4. Starane 250 EC (fluroxypyr)- 0,8 l/ha;
5. Glean 75 WG + Icedin forte (clorsulfuron + 2,4 D+ Dicamba)- 10 g/ha + 2 l/ha;
6. Icedin forte (2,4 D + Dicamba) – 2 l/ha.

We could not find a perfect positive relation between the weed control degree and wheat production, thus, considering the production level and the increases compared to the control variant, the best combinations were: 1. Icedin forte; 2. Granstar 75 DF; 3. Starane 250 EC + SDMA-33; 4. Icedin super; 5. Grodyl 75 WG, 6. Sansac.

The weeds that resisted to these herbicides were : *Convolvulus arvensis, Cirsium arvense, Gallium aparine, Matricaria inodora, Echinocloa cruss-gali, Setaria gluca,* problem weeds in the wheat crop fields.

In this thesis we presented also the economical efficiency of the obtained results.

The economical efficiency determined in the case of applying nitrogen and phosphorus fertilizers depended on the production level and its determining factors, but also on the economical – financial conditions created by the increase of the technological costs and the selling price of the wheat production. The fertilizers costs raised every year.

The most economical efficient variants which also gave high productions proved to be, as average values on five years: $N_{120}P_{80}$, $N_{80}P_{80}$, $N_{60}P_{80}$, $N_{120}P_{40}$.

In the end of the doctoral thesis we emphasized the conclusions that resulted from the conducted researches and the proposals required to improve thw wheat cultivation technology in this area.