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# EFFECT OF AGROECOLOGICAL FACTORS ON WHEAT SEED PRODUCTION

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**ABSTRACT** - The paper analyses the seed production of NS wheat cultivars. In the period 1995-2007, seed production was organized at 29 259 ha on average. The average seed yield was 3.35 t/ha, exhibiting an upward trend at a rate of 3.22 % and high stability (CV = 17.09 %). The average production volume of 97,176 t on average had an upward trend at an annual rate of 2.08 % and high stability. The reasons for failing to achieve high seed yields in some years were unfavorable agroecological factors (precipitation distribution and temperatures).

**Key words:** wheat, seed, NS cultivars, agroecological factors, production parameters

## INTRODUCTION

Wheat (*Triticum sp.* L.) is a major field crop in Serbia, ranking second after corn. It is traditionally grown as a staple crop, the favorable growing conditions in the country explaining for a good measure of the status of the crop. Due to the properties of gliadin and glutenin, storage proteins in wheat endosperm and contents of starch, sugar, cellulose, fats, vitamins and minerals, wheat bread is currently the main item in the diet of more than 70 % of the global population (POPOVIC, 2010).

The volume of wheat production in the world, as well as in the Republic of Serbia, registers a continual growth. In the period 1995-2007, the average global wheat acreage was 217 million hectares (FAO, 2009). This makes about 26% of the global acreage of 850 million hectares of agricultural crops. The wheat acreage stagnated. The average global yield of wheat of 2.7 t/ha (FAO, 2009) registered a slight upward trend, at a rate of 0.88%, and high stability (CV= 4.52%). In the analyzed period, the volume of global wheat production was 591.6 million tons (FAO, 2009), recording stagnation or a slight upward trend, at an annual rate of 0.52% (POPOVIC, 2010). It is evident that the harvested acreage varied from year to year.

In the same period (1995-2007) in Serbia, the average wheat acreage was 662,743 ha. The acreage recorded a downward trend, at an annual rate of 2.72 %. The average wheat yield was 3.3 t/ha (FAO, 2009), or 0.6 t/ha above the world average. The yields recorded a slight upward trend, at a rate of 0.53%, and good stability (CV = 15.87 %). The average volume of wheat production in the analyzed period was 2.2 million tons (FAO, 2009), recording a downward trend at an annual rate of 2.21 % (POPOVIC, 2010). The wheat production in Serbia had been analyzed by a number of researchers (MALESEVIC ET AL., 2003, 2004, 2008, MLADENOVIC, ET AL., 2005, BROWN ET AL., 2008; DENCIC ET AL., 2009; HRISTOV ET AL., 2009, etc. ).

In the situation of a high market competition and availability of branded products from all parts of the world on the domestic market, producers and processors see their interest in marketing high quality products, particularly those declared as higher quality items (KOTLER, 2003). Seed can be rightfully qualified as one of these products. Quality seed is a precondition for a high and stable crop production. Controlled production of quality

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seed and marketing of certified seed are based on legal regulations and scientific grounds (MILOSEVIC, MALESEVIC, 2004).

Owing to the implementation of up-to-date cultural practices and high genetic potentials of its cultivars for yield performance and grain quality, Institute of Field and Vegetable Crops has so far successfully maintained the quality of seed of its wheat cultivars. The Institute's cultivars take over 90 % of the wheat market in Serbia (POPOVIC, 2010). Many cultivars had been registered and are grown abroad.

The objective of this study was to analyze the seed production of NS wheat cultivars. Important prerequisites for successful wheat production are the correct choice of appropriate cultivars for individual growing regions and use of quality seed. Bearing this in mind, Institute of Field and Vegetable Crops is doing its best to improve the quality of seed and other performances of the NS wheat cultivars.

## MATERIAL AND METHOD

This paper analyzes the seed production of wheat cultivars developed at Institute of Field and Vegetable Crops, labeled as NS cultivars, carried out in Serbia in the period 1995-2007. For that purpose we used original data from the Institute as well as data published by fao, 2009. The production was carried out under the supervision of the breeders of the considered cultivars, using up-to-date cultural practices.

The Institute's data on seed production of NS wheat cultivars included the yield of processed seed, which was determined by latest methods used in seed production. The data were statistically processed as follows (MIHAILOVIC, 2005):

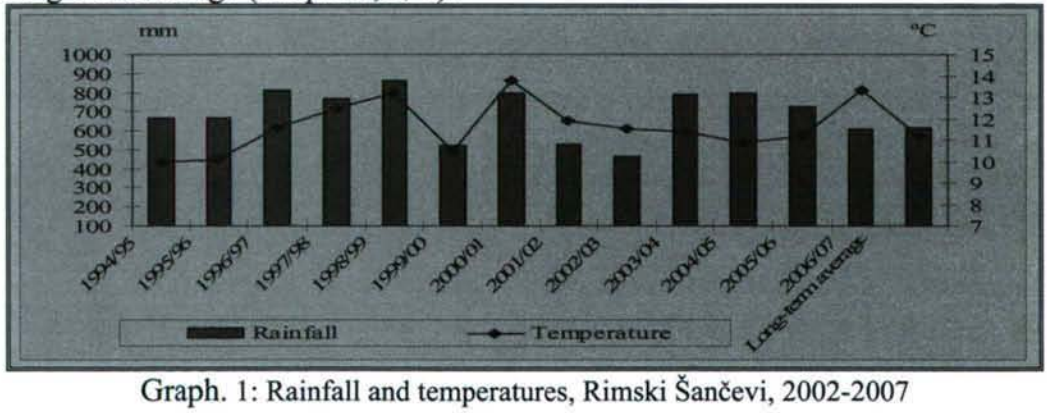
- degree of variation of individual parameters was calculated by the coefficient of variation,

$C_V = \sigma \cdot 100/\overline{X}$

- trends of individual parameters were calculated by the exponential trend equation,

$Yt = a\, b^{xi}$

Meteorological data for assessing the weather conditions were received from Rimski Šančevi meteorological stations, Novi Sad. According to these data, the average rainfall for the period 1995-2007 was 691.1 mm, higher by 73.1 mm than the long-term average for the location. The average annual temperature was 11.7 °C, higher by 0.52 °C than the long-term average (*Graph. 1, 2, 3*).




Graph. 1: Rainfall and temperatures, Rimski Šančevi, 2002-2007

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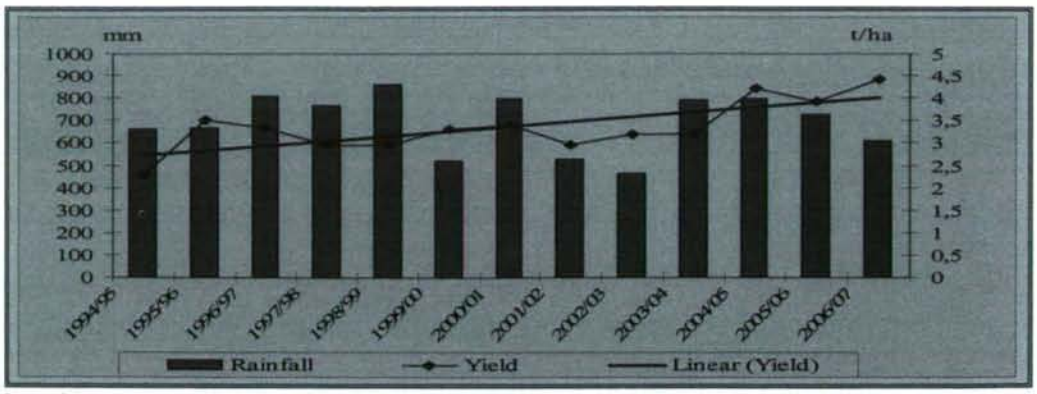
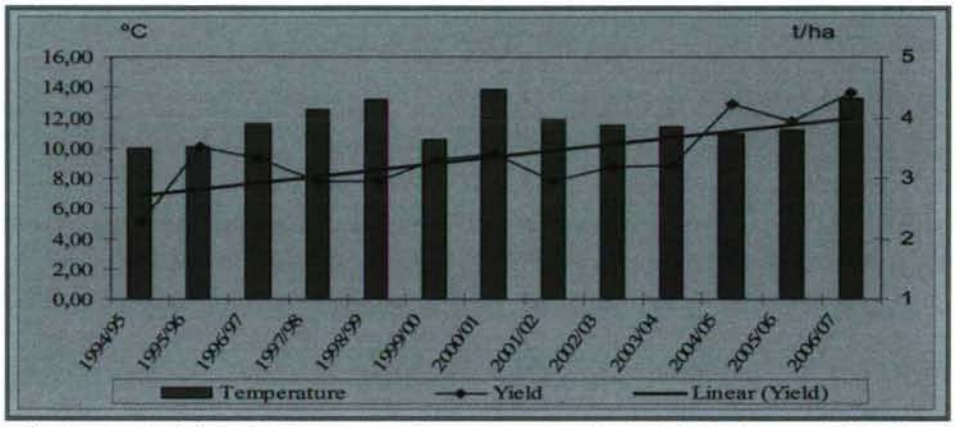



Graph. 2: Rainfall and seed yield of NS wheat grown in Serbia in the period 1995-2007




Graph. 3: Seed yield of NS wheat and temperatures in Serbia in the period 1995-2007

The data were analyzed by the statistical-mathematical procedures mentioned above. The seed production and its trends were presented in tables and graphs.

## RESULTS AND DISCSUSSION

In the analyzed period (1995-2007) in the Republic of Serbia, the average acreage used for seed production of NS wheat cultivars was 29259 ha. The acreage showed a downward trend at an annual rate of 1.18 % and stability (CV = 12.29 %; *Table 1 and Graph 4*).

Table 1: Wheat seed NS production in Serbia in the period 1995-2007

| Production parameters | Average values | Rate of change (%) | CV (%) |
|---|---|---|---|
| Acreage (ha) | 29,259 | -1.18 | 12.29 |
| Yield (t/ha) | 3.35 | 3.22 | 17.09 |
| Production volume (t) | 97,176 | 2.08 | 11.29 |
| Source: Calculated on the basis of data recorded at Institute of Field and Vegetable Crops, Novi Sad, 2009. | | | |

In the study period, the average yield of NS wheat cultivars was 3.35 t/ha, recording an upward trend at an annual rate of 3.22 %. The average seed yield of NS wheat cultivars showed a high stability (CV = 17.09 %; Popovic, 2010). The actual yields ranged from 2.26 t/ha (1995) to 4.41 t/ha (2007) (*Table 1, Graph 4*).

In the course of the study period, the wheat seed production in Serbia was conducted under different climatic (*Graph 1*) and soil conditions. When considering years as a

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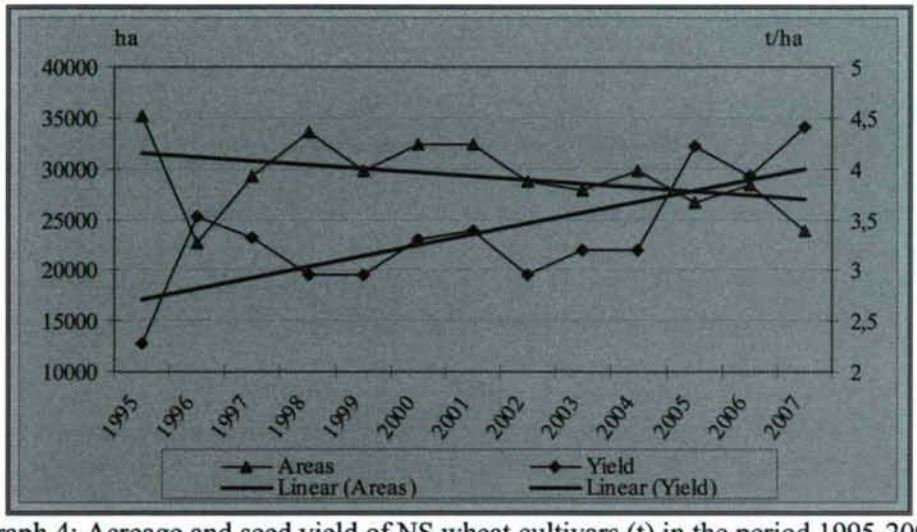
factor, large differences could be observed among them (variations in air temperature, amount and distribution of rainfall). The variations in weather conditions significantly affected wheat growth and development and the wheat yields varied accordingly (*Graph 2 and 3*). Significant annual differences in wheat seed yields resulted from extremely adverse weather conditions in 1995, unfavorable conditions in 1998, 1999 and 2002, and the relatively favorable conditions in 2007. The most favorable temperatures and water dynamics in 2007 brought the highest average seed yield of 4.41 t/ha. The 2007 rainfall was close to the long-term average figure. The average temperature was 13.3 °C, by 2.12 °C than the long-term average (*Graph 1*). The 2007 seed yield was by 2.14 t/ha than the yield achieved in 1995 and 1.46 t/ha higher than the yields achieved in 1998, 1999 and 2002 (*Graph 3*).



Graph 4: Acreage and seed yield of NS wheat cultivars (t) in the period 1995-2007

The most unfavorable year for wheat seed production in the study period was 1995, when the average yield was 2.27 t/ha. The 1995 average temperature was 10 °C, 1.18 °C lower than the long-term average for the locality. The amount of rainfall was 665 mm, which was 46 mm higher than the long-term average, but the distribution of rainfall was exceedingly unfavorable.

These results are in agreement with those of MALESEVIC (1990) who concluded that the cultivar by year interaction is high. The same author claimed that highest impacts on seed yield are exhibited by temperatures in March and June as well as by the rainfall in June, in the final stages of maturation and during harvest. Climate as a limiting factor is manifested through the occurrence of an extreme factor that is impossible to predict. In the case of record yields, direct positive effects of weather factors are recognized as favorable temperatures, rainfall amount and distribution, duration of solar radiation, wind, etc. (BEDO ET AL, 2001). Small grains are known for their sensitivity to moisture shortage or excess. In good years, the amount of rainfall is typically close to the long-term average or somewhat higher, and its distribution must be favorable. Long rainy spells are not desirable mainly due to reduced solar radiation. In good years, the production of organic matter is slightly increased. The intensity of organic matter accumulation is higher than in average years, and so is the intensity of translocation of nutrients in the grain (MALESEVIC ET AL., 2008). It should be added here that in good years the period from pollination to full maturity is longer than the average, lasting for 50-52 days. Since in good years the plants are shorter than in average years, the rate of nutrient transport to the grain is higher and translocation is more complete. This is why

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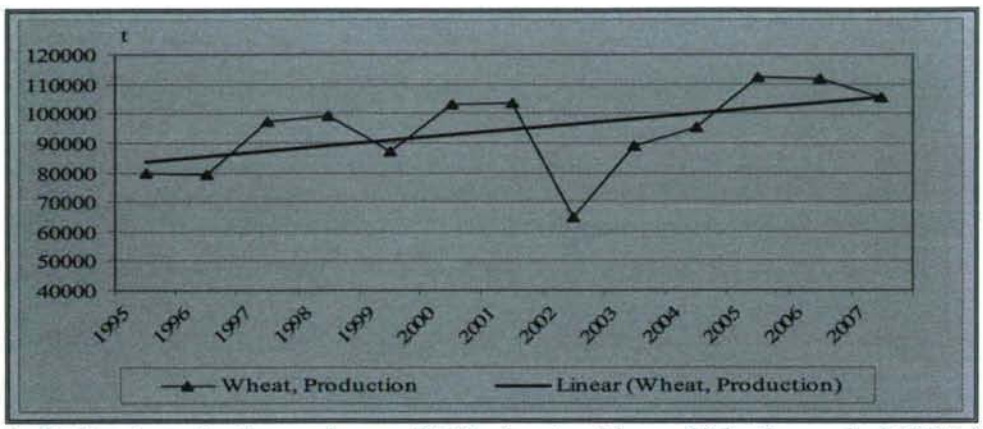
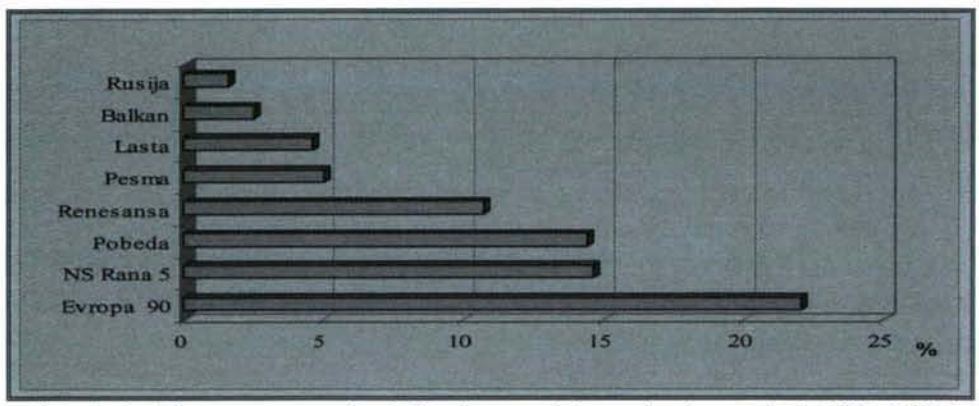
the high harvest index is closely associated with high yield performance. The grain to straw ratio is significantly in favor of the former, up to 58:42 (MALESEVIC, 2003).
Many studies have indicated that increased wheat yields may result from timely application of cultural practices (MALESEVIC, 2008). Proper and timely applied practices compensate for adverse environmental conditions.
The seed production of NS wheat cultivars records an upward trend. The increased production volume in the period 1995-2007 resulted from increased yields. During the analyzed period, the average production volume of NS wheat seed was 97,176 tons, with an upward trend at an annual rate of 2.08 % (*Table 1, Graph 5 and 6*).




Graph 5: Seed production volume of NS wheat cultivars (t) in the period 1995-2007




Graph 6: The most popular NS wheat cultivars in the period 1995-2007

The strategic goal of the Institute is the development of superior wheat cultivars for the domestic and foreign markets. The Institute's wheat breeders are aware of the importance of providing wheat growers with an array of NS wheat cultivars, to secure a high and stable production, minimize production costs and increase the profitability of wheat production (POPOVIC, 2010).
In the Republic of Serbia, local cultivars predominated in the wheat seed production. By 2008, 260 wheat cultivars were developed at Institute of Field and Vegetable Crops of which 34 were officially registered abroad (DENCIC ET AL. 2009). The seed production figures for NS wheat cultivars were affected not only by climatic factors but also by changes in the assortment, i.e. the introduction of new, higher yielding cultivars.

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## CONCLUSION

The analysis of 13-year data on seed production of NS wheat cultivars showed that there existed steady upward trends in yield performance and production volume.

- In the analyzed period, the average acreage used for seed production of NS wheat cultivars was 29,259 hectares. The acreage recorded a downward trend at an annual rate of 1.18 %.
- The average yield of processed seed of NS wheat cultivars was 3.35 t/ha, recording an upward trend at a rate of 3.22 % and good stability. The average yields varied from 2.27 (1995) to 4.41 t/ha (2007).
- The analysis showed that there existed a relationship between temperature conditions and seed yield. Lowest yields were achieved in 1995, when the temperature was 10 °C or 1.18 °C below the long-term average for Rimski Šančevi.
- The yields of seed wheat varied with the amount and distribution of rainfall in individual years. The maximum avarage yield of 4.41 t/ha was achieved in 2007, when the rainfall was at the level of the long-term average. The lowest average yield was achieved in 1995, the year with an unfavorable distribution of rainfall.
- In the analyzed period in Serbia, the seed production volume of NS wheat cultivars was 97,176 tons, with an upward trend at an annual rate of 2.08 %.

## REFERENCES

1. BEDŐ, Z., MALESEVIC, M., LANG, L. (2001): Exploitation of genetic yield potential of small bullets crops. 453-512. In: Toral B., Quarrie S.A., Janjic, V., Atanasov, A., Knezevic, D., Stojanovic, S. (eds), Genetics and Breeding of Small Grains. Agricultural Research Institute 'Serbia', Belgrade.
2. BRAUN, H., J., DIXON J., CROUCH, J., PAYNE, T. (2008): Wheat research to serve the future needs of the developing world. Proc. Int. Symp. „Conventional and Molecular Breeding of Field and Vegetable Crops", Novi Sad, 28-32.
3. DENČIĆ, S., KOBILJSKI, B., MLADENOV, N., PRZULJ, N. (2009): Proizvodnja, prinosi i potrebe za pšenicom u svetu i kod nas, Rat Pov / Field Veg Crop Res., Novi Sad, 367-377.
4. HRISTOV, N. MLADENOV, N., ĐURIC, VESELINKA, KONDIC-SPIKA, ANKICA, MARJANOVIC - JEROMELA, ANA, LECIC, NADA (2009): Genotipska varijabilnost sadržaja ulja kod pšenice, Rat Pov / Field Veg Crop Res., Novi Sad, 5-11.
5. KOTLER FILIP (2003): Kako kreirati, ovladati i dominirati tržištem. Asee Books, Novi Sad.
6. MALESEVIC. M. (1990): Značaj temperatura i padavina za određivanje optimalnih količina azota i njihov uticaj na visinu prinosa ozime pšenice (Triticum aestivum L.). Doktorska disetracija, Univerzitet u Novom Sadu, Poljoprivredni fakultet, Novi Sad.
7. MALESEVIC, M. (2003): Mineralna ishrana strnih žita u sistemu integralnog ratarenja, „Zbornik radova", Naučnog Instituta za ratarstvo i povrtarstvo, Novi Sad, 179-195.
8. MALESEVIC, M., PANKOVIC, L. (2004): Izmenjena tehnologija gajenja strnih žita u uslovima promene klime, Rat Pov / Field Veg Crop Res., Novi Sad, 83-90.
9. MALESEVIC, M. (2008): Mineral nutrition of small grains in integrated crop menagement system. Rat Pov / Field Veg Crop Res., 179-193.
10. MIHAILOVIC, B. (2005): Marketing, Cetinje, 1-548.
11. MILOSEVIC, MIRJANA, MALESEVIC, M. (2004): Semenarstvo, Naučni institut za ratarstvo i povrtarstvo, Novi Sad, str. 70-75.

ISSN 1788-5345

12. MLADENOVIC, G., KOVACEVIC, N., DRAZIC, TANJA (2005): Proizvodnja i promet semena NS sorti strnih žita u 2004/05. godini, Rat Pov / Field Veg Crop Res., Novi Sad, 507-514.
13. POPOVIC VERA (2010): Agrotehnički i agroekološki uticaji na proizvodnju semena pšenice, kukuruza i soje. Doktorska disertacija, Univerzitet u Beogradu, Poljoprivredni fakultet Zemun, 1-145.
14. http://faostat.fao.org/