

# INFLUENCE OF FUNGICIDE TREATMENTS ON WHEAT YIELD AND QUALITY IN TRANSYLVANIA – ROMANIA

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## ABSTRACT

The effect of one (at the end of flowering) or two (at flag leaf emergence and end of flowering) foliar treatments with fungicides (fenpropimorph 250 g/l and epoxiconazole 84g/l at 1 l/ha) on yield and gluten content of 5 winter wheat cultivars was studied at ARDS Turda in a mid-humid area of Transylvania. One treatment reduced the diseased leaf area on average by 50%, and the number of diseased spikes by 47%, increasing the grain yield by 3-8%. Two treatments reduced the diseased leaf area on average by 80%, and the number of diseased spikes by 77%, increasing the grain yield by 8-16%. Wet gluten content was increased on average by 5% with one treatment, and by 10% with two treatments. Foliar fungicide treatments have to be included in the disease control strategy for present wheat cultivars in the humid and mid-humid areas of Transylvania.

**Key words :** foliar diseases, fungicide treatments, wheat

## INTRODUCTION

Wheat crops are damaged by many diseases which cause quantitative and especially qualitative yield losses in Transylvania (Nagy and al., 2002; Nagy and Kadar, 2004). The complex of foliar diseases : powdery mildew (*Blumeria graminis* f. sp. *tritici*), leaf and glume blotch (*Septoria tritici* and *Stagonospora nodorum*), rusts (*Puccinia striiformis*, *Puccinia recondita* and *Puccinia graminis*) and tan spot (*Pyrenophora tritici* – *repentis*) as well as head blight (*Fusarium* spp.) and ears blackening (*Alternaria* and *Cladosporium*) are the most frequent in wheat crops (Shaner and Buechley, 1999; Gooding et al., 2002). Yield losses, reaching up to 30% of yield, depend on weather conditions and wheat cultivar. The paper presents the results obtained regarding protection of wheat crop against foliar and ear diseases in A.R.D.S. Turda, during 2001-2003.

## MATERIAL AND METHODS

The effect of fungicide foliar treatments on winter wheat was studied at A.R.D.S. Turda dur-

ing 2001-2003. A split-plot bifactorial trial with 3 treatments: untreated (T0), 1 treatment (T1) applied at the end of flowering (ZGS73) and treatment (T2) applied at flag leaf emergence (ZGS38) and at the end of flowering (ZGS73) was organized. The winter wheat cultivars: Transylvania, Ariesan, Apulum, Turda 95 and Turda 2000 were studied. The used fungicides were: fenpropimorph 250g/l and epoxiconazole 84g/l at dose 1,0 l/ha. In the field, attack degree of main diseases (%) and yield (q/ha) and in the laboratory dry and wet gluten content (%) were determined. The obtained results were statistically processed using ANOVA, regression and correlation methods.

## RESULTS AND DISCUSSION

The weather conditions from April, May, June months of 3 years, characterized by high temperature associated with strong water deficit, were less favourable for the diseases occurrence, known to be essentially weather-dependent. Foliar diseases: powdery mildew, leaf rust, leaf blotch and ears blackening were present in wheat. The attack degree of foliar diseases in relationship with number of fungicide treatments is shown in figure 1. Necrosed leaf area averaged 29.1%, from which powdery mildew was dominating (14.6%), followed by leaf rust (11.8%) and leaf blotch (2.7%). Among the wheat cultivars the most susceptible were Turda 2000 and Apulum with 37.3% and 34.2% necrosed leaf area and the more tolerant Turda 95 and Ariesan with 19.5% and 23.1% respectively.

By applying one single fungicide treatment, leaf area attacked by foliar diseases was significantly reduced in average with 50%, and even more in Transylvania and Apulum cultivars. Applying 2 treatments substantially reduced diseased leaf area (5.8%) with positive effect on yield. The yield increase from applying one foliar treatment

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was on average 5.6%, while after two treatments the yield increase

Figure 2. The influence of foliar fungicides on yield in 5 wheat cultivars (Turda, 2001-2003)

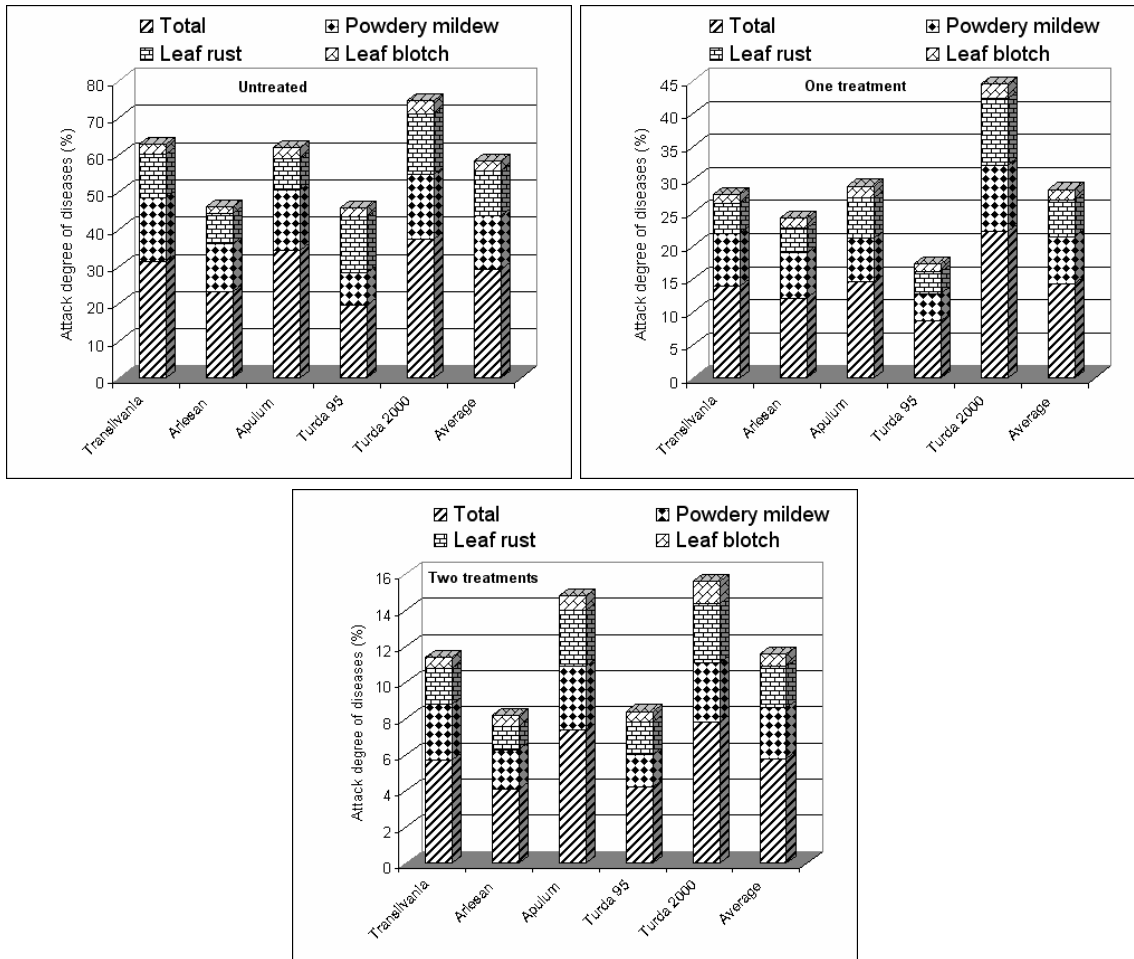


Figure 1. The attack degree of foliar diseases in relationship with treatment number (Turda, 2001-2003)

was of 10.5%. For the cultivar Turda 2000 the yield (averaged on three years) increased from 49.9 to 55.7 q/ha (Figure 2).

The influence of fungicide treatments on ear blackening (*Alternaria*, *Cladosporium*) and yield in 5 wheat cultivars is presented in table 1. Two foliar treatments decreased significantly ear blackening under 5% in these 3 years, including the Turda 2000 cultivar, which is the most susceptible. Yield gains were between 3-8% for one treatment and between 8-16% for two treatments using Tango Super (1.0 l/ha) fungicide. Turda 95, Turda 2000 and Ariesan had the highest yields in 2002, reaching 72.6-74.7 q/ha.

Besides substantially significant yield gains, the gluten content was improved. Applying two treatments with fungicides determined an obvious increase of up to 17.0% for wet gluten (Table 2) and to 9.0% for dry gluten content (Table 3).

These results suggest that the treatments with foliar fungicides have to be included in disease

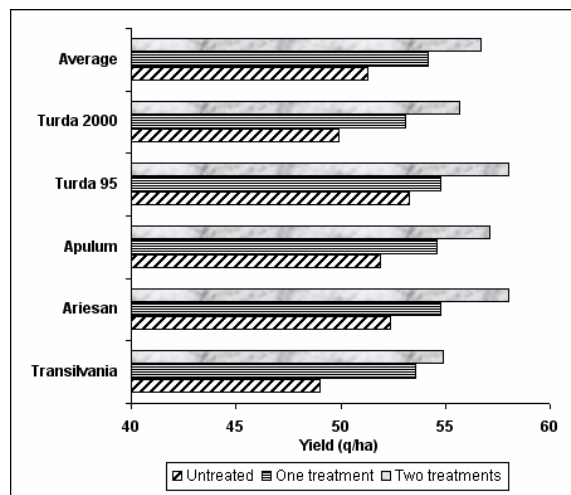


Table 1. The influence of fungicides treatments on the ears blackening (*Alternaria*, *Cladosporium*) and yield in 5 wheat cultivars (Turda, 2001-2003)

| Years | Cultivars    | Untreated           |              | 1 treatment        |              | 2 treatments       |              |
|-------|--------------|---------------------|--------------|--------------------|--------------|--------------------|--------------|
|       |              | Diseased spikes (%) | Yield (q/ha) | Diseased spikes(%) | Yield (q/ha) | Diseased spikes(%) | Yield (q/ha) |
| 2001  | Transilvania | 15.3                | 50.3         | 7.7                | 52.5         | 2.0                | 55.4         |
|       | Ariesan      | 13.3                | 52.5         | 7.0                | 53.1         | 1.3                | 56.8         |
|       | Apulum       | 18.7                | 55.9         | 9.0                | 57.9         | 3.7                | 59.5         |
|       | Turda 95     | 7.7                 | 58.4         | 4.0                | 59.2         | 1.0                | 61.2         |
|       | Turda 2000   | 26.0                | 48.4         | 11.0               | 51.7         | 4.3                | 55.1         |
|       | Average      | 15.3                | 53.1         | 7.7                | 54.9         | 2.5                | 57.6         |
| 2002  | Transilvania | 12.0                | 64.8         | 7.0                | 70.6         | 3.0                | 71.2         |
|       | Ariesan      | 9.0                 | 69.9         | 5.0                | 73.1         | 2.0                | 74.7         |
|       | Apulum       | 18.0                | 62.6         | 8.0                | 65.7         | 4.0                | 68.3         |
|       | Turda 95     | 10.0                | 66.1         | 6.0                | 68.4         | 3.0                | 72.6         |
|       | Turda 2000   | 20.0                | 67.4         | 10.0               | 72.6         | 5.0                | 74.5         |
|       | Average      | 13.8                | 66.2         | 7.2                | 70.1         | 3.4                | 72.2         |
| 2003  | Transilvania | 15.7                | 31.9         | 6.3                | 37.6         | 4.3                | 38.1         |
|       | Ariesan      | 9.3                 | 34.8         | 4.7                | 38.1         | 2.3                | 42.4         |
|       | Apulum       | 9.7                 | 37.3         | 6.3                | 40.1         | 3.3                | 43.6         |
|       | Turda 95     | 9.3                 | 35.4         | 6.7                | 36.9         | 4.0                | 40.2         |
|       | Turda 2000   | 11.7                | 34.0         | 8.3                | 34.9         | 4.3                | 37.4         |
|       | Average      | 11.1                | 34.6         | 6.4                | 37.5         | 3.6                | 40.3         |

control strategy of wheat crops in humid and mid-humid areas of Transylvania.

0.1%

0.8

x - control

Table 2. Effect of fungicide treatments on the wet gluten content in 5 wheat cultivars (Turda, 2001-2003)

| Factors       | Wet gluten       |                     |                     |        |
|---------------|------------------|---------------------|---------------------|--------|
|               | abs.             | relative.           | diff.               | signif |
| A. Years      |                  |                     |                     |        |
| 2001          | 24.9             | 100                 | 0.0                 | x      |
| 2002          | 22.0             | 88.0                | -2.9                | ooo    |
| 2003          | 31.4             | 128.0               | 6.5                 | ***    |
| LSD 5%        | 0.3              |                     |                     |        |
| B. Treatments |                  |                     |                     |        |
| Untrated      | 24.9             | 100                 | 0.0                 | x      |
| 1 Treatment   | 26.2             | 105                 | 1.3                 | ***    |
| 2 Treatments  | 27.3             | 110                 | 2.4                 | ***    |
| LSD 5%        | 0.2              |                     |                     |        |
| C. Cultivars  |                  |                     |                     |        |
| Cultivars     | Un-trated – abs. | 1 Treat-ment – abs. | 2 Treatments – abs. |        |
| Transilvania  | 24.2             |                     | 25.5***             |        |
| Ariesan       | 25.0             | 23.9                | 29.2***             |        |
| Apulum        | 24.8             | 27.0 ***            | 26.6***             |        |
| Turda 95      | 24.6             | 27.1***             | 26.9***             |        |
| Turda 2000    | 26.0             | 25.6***             | 28.4***             |        |
|               |                  | 27.1***             |                     |        |

LSD 5%

0.5

1%

0.6

Table 3. The influence of fungicide treatments on the dry gluten content in 5 wheat cultivars (Turda, 2001-2002)

| Factors        | Dry gluten       |                     |                     |        |
|----------------|------------------|---------------------|---------------------|--------|
|                | absolute         | relative            | diff.               | signif |
| A. Years       |                  |                     |                     |        |
| 2001           | 8.0              | 100                 | 0.0                 | x      |
| 2002           | 8.6              | 107                 | 0.6                 | -      |
| LSD 5%         | 1.6              |                     |                     |        |
| B. Treatments  |                  |                     |                     |        |
| Untrated       | 8.1              | 100                 | 0.0                 | x      |
| 1 Treatment    | 8.3              | 102                 | 0.2                 | **     |
| 2 T treatments | 8.5              | 106                 | 0.5                 |        |
| LSD 5%         | 0.3              |                     |                     |        |
| C. Cultivars   |                  |                     |                     |        |
| Cultivars      | Un-trated – abs. | 1 Treat-ment – abs. | 2 Treatments – abs. |        |

|              |     |        |        |
|--------------|-----|--------|--------|
| Transilvania | 7.8 | 7.7    | 8.1*   |
| Ariesan      | 8.6 | 8.6    | 9.0**  |
| Apulum       | 7.6 | 8.4*** | 7.9*   |
| Turda 95     | 8.0 | 8.1    | 8.7*** |
| Turda 2000   | 8.5 | 8.6    | 9.0**  |

LSD 5%

0.3

1%

0.1%

0.4

0.6

x - control

## CONCLUSIONS

Treatments with foliar fungicides allow the manifestation of the high yielding potential of wheat cultivars, both yield and quality gains being significant.

Applying one foliar treatment at the end of flowering determined yield gains of 3-8% and two treatments increased yield by 8-16%.

Wet and dry gluten content was positively influenced by the fungicide treatments. Wet gluten

content increased on average with 5%, with variation between 4-17% and dry gluten between 4-9%, depending on wheat genotype.

The highest yield gains, reaching up to 12.0% on three years average were obtained in cultivars Transylvania and Turda 2000. In the cultivar Ariesan the wet gluten content was increased by 17.0%.

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Table 1

Average yield of experiments with winter wheat cultivars, under irrigation and dry-land in six localities from the South of Romania  
(2002)

| Locality   | Average yield under:  |                     | Yield percentage<br>diminution |
|------------|-----------------------|---------------------|--------------------------------|
|            | irrigation<br>(kg/ha) | dry-land<br>(kg/ha) |                                |
| Caracal    | 8560                  | 5601                | 34.6                           |
| Marculesti | 4716                  | 3075                | 34.8                           |
| Teleorman  | 5963                  | 3594                | 39.8                           |
| V. Traian  | 6941                  | 3794                | 45.3                           |
| Fundulea   | 4858                  | 1918                | 60.5                           |
| Simnic     | (8560)                | 380                 | 95.6                           |

Table 2

Percentage diminution of some plant features under water stress conditions  
as compared to irrigation

| Locality  | Plant number | Plant height | Grain filling<br>period | Spike<br>number | Grain/ear | TKW  | Test weight |
|-----------|--------------|--------------|-------------------------|-----------------|-----------|------|-------------|
| Caracal   | 0            | 14,9         | 15,0                    | 7,9             | 10,2      | 14,1 | 0,9         |
| Teleorman | 0            | 10,0         | 19,2                    | 12,0            | 12,0      | 11,9 | 1,0         |
| V.Traian  | 34,9         | 21,0         | 16,9                    | 42,5            | 12,2      | 2,9  | 8,1         |
| Fundulea  | 4,9          | 28,8         | 24,9                    | 6,9             | 28,9      | 29,5 | 3,9         |
| Simnic    | 27,6         | 61,7         | 30,0                    | 65,0            | 64,5      | 53,1 | 10,7        |
| Media     | 13,5         | 27,3         | 21,2                    | 26,9            | 25,6      | 22,3 | 4,9         |

Table 3

Minimum, maximum and average yields registered at Fundulea in 2002 in international trials WWEERYT with genotypes grouped  
depending on the originating country

| Source | Average yield of the | Maximum yield of the tested | Minimum yield of the |
|--------|----------------------|-----------------------------|----------------------|
|--------|----------------------|-----------------------------|----------------------|

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|                   | tested genotypes<br>(kg/ha) | genotypes<br>(kg/ha) | tested genotypes<br>(kg/ha) |
|-------------------|-----------------------------|----------------------|-----------------------------|
| Romania           | 2368                        | 2953                 | 2073                        |
| Russia            | 2327                        | 2453                 | 1980                        |
| Ukraina-Odessa    | 2224                        | 3013                 | 1287                        |
| Hungary           | 2181                        | 2780                 | 1320                        |
| Ukraina-Mironovka | 2108                        | 2753                 | 1500                        |
| Moldova           | 1927                        | 2560                 | 1293                        |
| Bulgaria          | 1898                        | 2873                 | 1313                        |
| Turkey            | 1893                        | 2420                 | 1487                        |
| Azerbaijan        | 1460                        | 1553                 | 1367                        |
| Kazakhstan        | 1422                        | 1833                 | 853                         |
| LSD 5%            | 243                         | 275                  |                             |

Table 4

Correlations between yield under water stress conditions and different traits

| Locality    | Average yield diminution because of water stress (%) | Correlation coefficients between yield under water stress conditions and: |                                      |                               |              |                      |             |       |
|-------------|--|---|--------------------------------------|-------------------------------|--------------|----------------------|-------------|-------|
|             |  | yield under irrigation  | plant height under stress conditions | plant height under irrigation | heading time | spike/m <sup>2</sup> | grain/ear   | TKW   |
| Caracal     | 34,6   | <b>0,48</b>   | 0,29                                 | -0,31                         | -0,12        | 0,20                 | 0,11        | -0,30 |
| Teleorman   | 39,8   | <b>0,80</b>   | 0,35                                 | 0,31                          | <b>-0,85</b> | <b>0,58</b>          | -           | -     |
| Valu Traian | 45,3   | 0,04  | 0,33                                 | 0,20                          | <b>-0,40</b> | <b>0,42</b>          | <b>0,40</b> | 0,22  |
| Fundulea    | 60,5   | 0,00  | <b>0,46</b>                          | -0,31                         | <b>-0,46</b> | <b>0,52</b>          | 0,30        | -0,17 |
| Simnic      | 95,6   | -0,01   | <b>0,41</b>                          | <b>-0,62</b>                  | -0,04        | <b>0,40</b>          | <b>0,50</b> | 0,15  |

The bold characters are significant at the probability level of 0.05

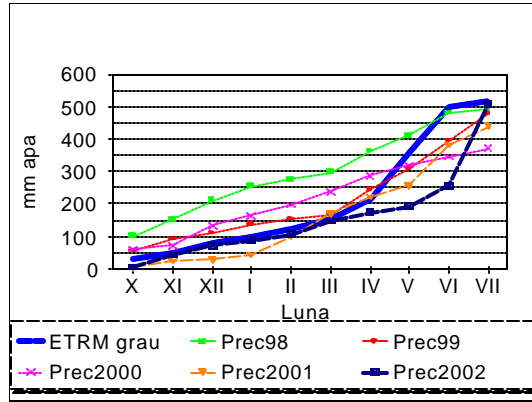


Figure 1. Average evapotranspiration and rainfall during 1999-2002 at Fundulea (mm water; month; wheat evapotranspiration; rainfall)

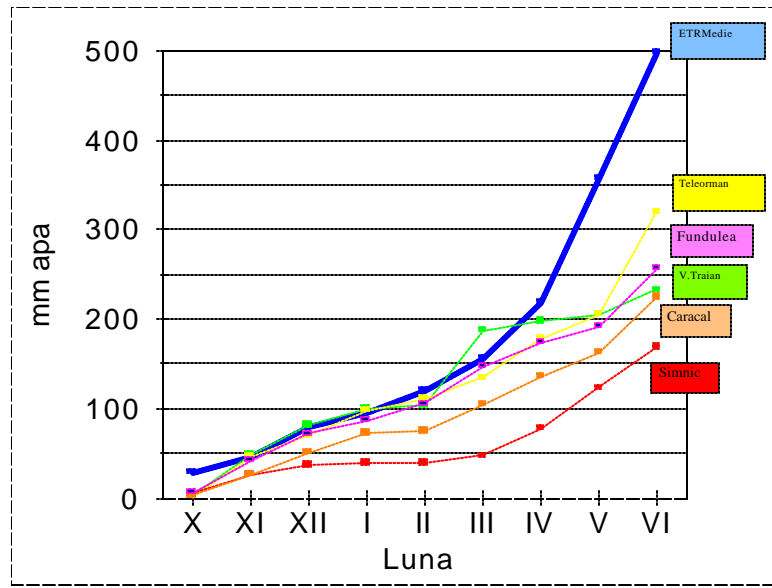


Figure 2. Average evapotranspiration and rainfall during the vegetation period in six locations of Southern of Romania in 2001-2002 year (mm water; month).

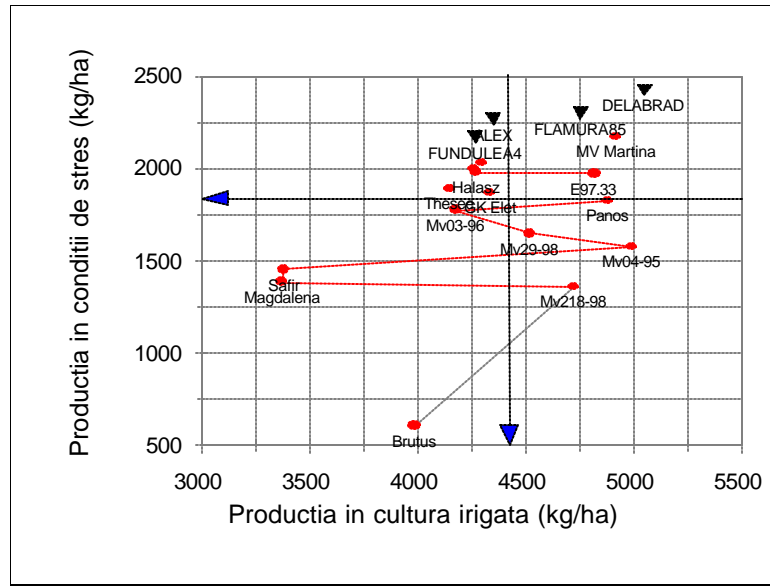


Figure 3. Yield obtained by some Romanian and foreign cultivars under irrigation and non-irrigation, in 2002 at Fundulea (arrows indicate the experiments average yield)(Yield under stress conditions; yield under irrigation).

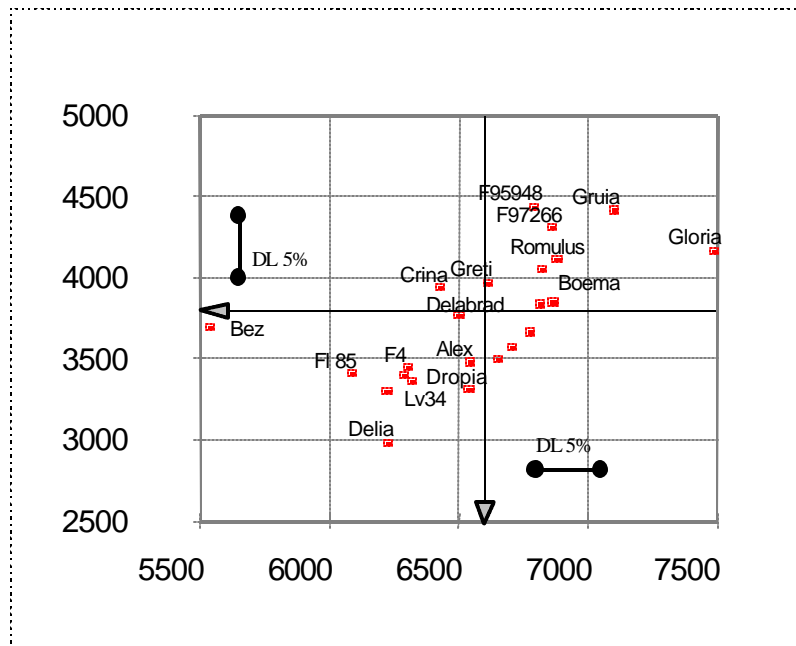


Figure 4. Average yields in four locations, obtained in 2002 by Romanian new lines and cultivars under irrigation and non-irrigation (arrows indicate experiments average yield)(Yield under non-irrigation; Yield under irrigation; LSD).



