

THE INFLUENCE OF TREATMENTS WITH DIFFERENT PHYTOSANITARY PRODUCTS (FUNGICIDES) ON THE ATTACK OF SOME PHYTOPATHOGENIC FUNGI AND ON WHEAT HARVEST – ANDINO VARIETY - IN 2017 PEDOCLIMATIC CONDITIONS OF THE EASTERN BARAGAN

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Abstract

This study aims at monitoring the dynamics of the occurrence and evolution of the attack of some pathogenic agents to wheat – Andino French variety. Among these, we mention: *Puccinia recondita* f. sp. *tritici* (sin. *Puccinia triticina*) which produces wheat's brown rust and *Septoria* sp which produces wheat's brown leaf spotting (septoriosis). Also, the influence of applying these fungicides on the harvest was monitored, as compared to the untreated control variant. 2 experiments with 4 variants (3 variants with phytosanitary treatment, plus a control variant not treated) were taken into consideration for this study, for which 3 phytosanitary products were used, as follows: FALCON 460 EC (proquinazid + tebuconazole+ prochloraz); MYSTIC 250 EC (tebuconazole); TOPSIN 500 SC (thiophanate-methyl); BUMPER 250 CE (propiconazole). The treatment variants were the following at the first experiment: **V1** – FALCON 460 EC – 0.6 L/HA 1 treatment applied at straw's extension + 1 treatment applied at berries' filling; **V2** – MYSTIC 250 EC 0.5 L/HA -1 treatment applied at straw's extension (0.6 l/ha) + 1 treatment applied at berries' filling (0.7 l/ha); **V3** – TOPSIN 500 SC 1 L/HA + BUMPER 250 CE 0.25 L/HA - 1 treatment applied at straw's extension + 1 treatment applied at berries' filling; **V4** – Control variant not treated. The experiment was placed in Latin square, the 4 variants being placed in 4 repetitions. Among the pathogenic agents under monitoring, *Puccinia recondita* f.sp. *tritici* fungus, producing the brown rust and fungi from *Septoria* sp. species, producing the brown leaf spotting (septoriosis), had produced the greatest attacks. The first two leaves placed under the wheat ear had been analyzed for the above. These observations had led to the conclusion that for all 3 treatment variants, the degree of attack (D.A. %) of the two diseases was more reduced than at the untreated control variant. The harvests of the treated variants (V1 – 9.14 t/ha, V2 – 9.32 t/ha, V3 – 8.55 t/ha) were higher than the harvest of the untreated control variant V4, being of 8.69 t/ha. The treatment variants at the second experiment were identical with the ones from the first experiment in what concerns the products used. The difference consisted in the fact that one single treatment was executed at wheat plants' blooming at the second experiment. For this experiment, the harvests were: 8.497 t/ha at the untreated control variant (V4), while at the other 3 variants were: V1 – 9.625 t/ha, V2 – 9.570 t/ha and V3 – 8.442 t/ha.

Key words: *Puccinia*, *Septoria*, Latin square

The wheat, *Triticum aestivum*, is attacked by many pathogenic agents, such as: mildew - *Blumeria graminis* f.sp. *tritici*, brown rust - *Puccinia recondita* f. sp. *tritici*, brown leaf spotting - *Septoria tritici*, *Septoria nodorum*, stem's fusariosis and spike's burn *Giberella zeae*, *Giberella avenacea* (Iacob Viorica, Hatman, M., Ulea, E., Puiu, I. 1998). The first half of the year 2017 was difficult for wheat, in what concerns the climatic conditions. Abundant rainfalls and low temperatures had been registered in this period. The rain had taken the form of slesh and even snow between 19th and 21st April. The snow layer persisted for more than 36 hours. After snow's

melting, the weather had been moist and relatively cold up to the middle of June. Accordingly, favorable conditions for the attack of some pathogenic agents specific to wheat had appeared.

Here we mention especially *Puccinia recondita* f. sp. *tritici* fungus which produces the disease called brown rust at wheat. This pathogenic agent attacks the wheat crops every year, at high attack intensities. The other mentioned pathogenic agents have proven to be less dangerous for wheat's crop, in the climatic conditions of the year 2017.

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Table 1

The results of the first experiment (the first treatment applied at straw's extension, the second at berries' filling with fungicide products (3 variants of treatment + 1 control variant not treated) in what concerns the cumulated attack (D.A.%) of *Puccinia recondita* f. sp. *Tritici* and *Septoria* sp. fungi at wheat ("flag" leaf and the next leaf).

The observations had been made on 16th June, 2017

Variant	"Flag" leaf			The second leaf		
	D.A%	Dif. against the control variant	Significance	D.A%	Dif. against the control variant	Significance
-V1 FALCON 460 EC– 0.6 L/HA	0,7	25.1	**	26.1	37.7	**
-V2 MYSTIC 250 EC 0.5 L/HA 1	0,8	25.0	**	30.5	33.3	**
-V3 TOPSIN 500 SC 1 L/HA+ BUMPER 250 CE 0.25 L/HA	8.5	17.3	**	46.8	17.0	*
-V4 Untreated control variant	25.8	-		63.8	-	-

LD (Limit differences) D.A. (Degree of attack) % for the "flag" leaf

LD 5%=6.87%

LD 1%=9.88%

LD D.A. % for the second leaf

LD 5%=13.18%

LD 1% =18.95%

Table 2

The results of the second experiment (one single treatment applied at wheat's blooming) with fungicide products (3 variants of treatment + 1 control variant not treated) in what concerns the cumulated attack (D.A.%) of *Puccinia recondita* f. sp. *Tritici* and *Septoria* sp. fungi at wheat ("flag" leaf and the next leaf).

The observations had been made on 16th June, 2017

Variant	"Flag" leaf			The second leaf		
	D.A%	Dif. against the control variant	Significance	D.A%	Dif. against the control variant	Significance
-V1 FALCON 460 EC – 0.6 L/HA	10.6	28.8	**	61.3	18.7	**
-V2 MYSTIC 250 EC 0.5 L/HA 1	10.2	29.2	**	60.0	20	**
-V3 TOPSIN 500 SC 1 L/HA+ BUMPER 250 CE 0.25 L/HA	25.9	13.5	**	81.3	-1.3	-
-V4 Untreated control variant	39.4	-	-	80.0	-	-

LD (Limit differences) D.A. (Degree of attack) % for the "flag" leaf

LD 5% = 9.02%

LD 1% = 12.90%

LD D.A. % for the second leaf

LD 5% = 6.7%

LD 1% = 9.6%

Table 3

The results of the first experiment (the first treatment applied at straw's extension, the second at berries' filling with fungicide products (3 variants of treatment + 1 control variant not treated) in what concerns the production (t/ha) obtained at the treated variants as compared to the untreated control variant

Variant	Prod. (t/ha)	Difference against the control variant (t/ha)	Significance
V1 FALCON 460 EC – 0.6 L/HA	9.14	0.45	*
V2 MYSTIC 250 EC 0.5 L/HA	9.32	0.63	**
V3 TOPSIN 500 SC 1 L/HA+ BUMPER 250 CE 0.25 L/HA	8.55	-0.14	-
V4 Untreated control variant	8.69	-	-

LD 5% = 0.39 t/ha

LD 1% = 0.59 t/ha

Table 4

The results of the second experiment (one single treatment applied at wheat's blooming) with fungicide products (3 variants of treatment + 1 control variant not treated) in what concerns the production (t/ha) obtained at the treated variants as compared to the untreated control variant

Variant	Prod. (t/ha)	Difference against the control variant (t/ha)	Significance
V1 FALCON 460 EC – 0.6 L L/HA	9.625	1.128	**
V2 MYSTIC 250 EC 0.5 L/HA 1	9.570	1.073	**
V3 TOPSIN 500 SC 1 L/HA+ BUMPER 250 CE 0.25 L/HA	8.442	-0.055	-
V4 Untreated control variant	8.497	-	-

LD 5% = 0.64 t/ha

LD 1% = 0.98 t/ha

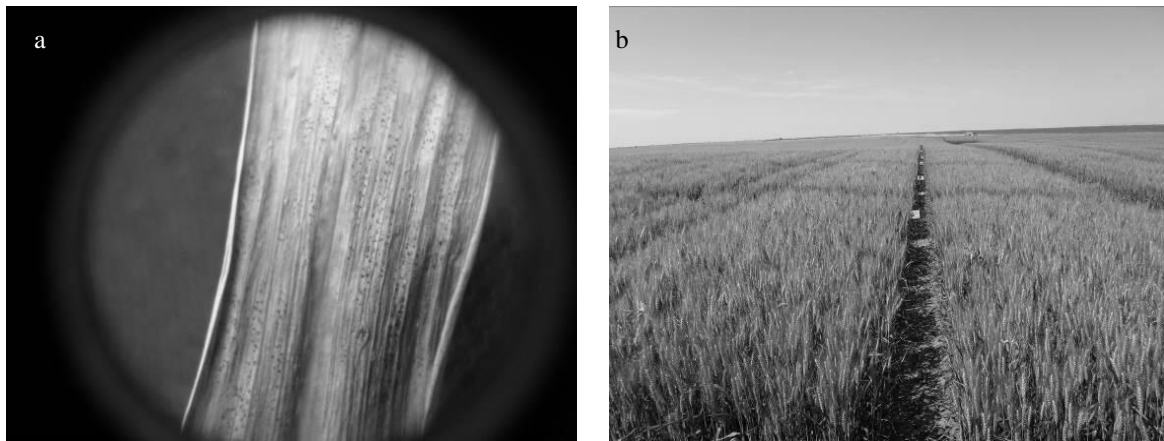


Figure 1 a – Attack of *Septoria sp. – picnidia* (original) b – Aspects from the experiment field

MATERIAL AND METHOD

2 experiments with 4 study variants each had been conceived for performing the observations. These experiments comprised 3 phytosanitary treatment variants (fungicide products containing various active substances) and one control variant not treated.

The experiment variants were the following (tabel 1):

- V1 – FALCON 460 EC– 0.6 L/HA;
- V2 – MYSTIC 250 EC 0.5 L/HA;
- V3 – TOPSIN 500 SC 1 L/HA + BUMPER 250 CE 0.25 L/HA;
- V4 – Control variant not treated.

Two phytosanitary treatments were applied at the first experiment, the first at straw's extension and the second at berries' filling. In what concerns the second experiment, one single treatment was applied in the wheat plants' blooming phase.

The experiment was placed in Latin square, the 4 variants being placed in 4 repetitions. Each experimental plot had an area of 15 m² (5 x 3m). The total number of experimental plots was 16 for each and every experiment. As only two separate experiments were involved, this study had in total 32 experimental variants. The surface of an experimental variant was of 15 m² x 4 repetitions = 60 m². The total area of the experiment was of 60 m² x 4 = 240 m². The study had in total an area of 480 m². The treatments had been done manually, with a "Vermorel" type of equipment. "Trend" adjuvant product was added, in concentration of 0.03%, in the spraying solution. Weeds were fought against with the help of Granstar herbicide in a dosage of 40 g/ha applied, separately, with the Vermorel. An insecticide product was also added (Karate Zeon – 0.15 l/ha) in the herbicide solution for fighting against cereals' bugs - *Eurygaster sp.*

The purpose of the experiment had been the efficiency of the mentioned phytosanitary products, as reported to their price, as well as the efficiency and respectively, the profitability of applying one or two phytosanitary treatments during the wheat's vegetation period.

The assessment of the attack's frequency (F %), of attack's intensity (I %) and respectively of the degree of attack (D.A. %) was done separately, on each and every experimental plot, being analyzed 5 plants / experimental plot. The degree of affectation (attack intensity I %) of the last two leaves was assessed, especially of the "flag" leaf which has the greatest contribution to the ear's production at strawy cereals. The phytosanitary analyses on the plants' samples had

been done with the help of the stereo-microscope and of the optic microscope at the laboratory of Braila's Phytosanitary Office – National Phytosanitary Authority. These analyses have revealed the presence of *Puccinia recondita* f.sp. *tritici* fungus in the analyzed samples, which produces wheat's brown rust.

For assessing the production of each variant under study, samples of berries from each experimental plot, 5 samples each / plot, had been analyzed by spot check. Each sample contained 10 plants so, 50 plants had been taken from each experimental plot, for which the production was processed and weighted manually. The delimitation of each sample was done with a metric frame with an area of 0.25 m² (0.5/0.5m). The average of the samples from the experimental plots was used for calculating the production of each and every experimental parcel. As it is about experiments placed in Latin square, the production of variants, repetitions and columns of the two experiments from the study has been had in view. The statistic interpretation was executed with the help of limit differences (LD %) (Săulescu N).

Andino was the variety used for study. It is a French wheat variety produced by Limagrain Verneuil Holding. The variety is resistant to mildew, medium resistant to brown rust and sensitive to septoriosiis (Agricultural Gazette 2012).

The assessment of the attack of pests can be done with the help of the following values (Methods of Prognosis and Warning 1980):

- Frequency of attack (F %);
- Intensity of attack (I %);
- Degree of attack (D.A. %).

- Attack's frequency represents the relative value of the number of plants or organs of the plant under attack (n) reported to the number of plants or organs observed (N). The value of the frequency is established by direct observation on a number of plants or organs, according to the case and to the conditions, existing different methods of sample taking and of performing the observations. In the case of our observations, for the foliar diseases, it was taken into consideration the number of attacked plant organs out of the total of observed plant organs (leaves), being thus established the attack's frequency expressed in percentages %. In the case of blight, it is used the number of attacked wheat ears reported to the total number of observed wheat ears. The frequency is calculated with the formula $F\% = \frac{n \times 100}{N}$.

- Attack's intensity represents the degree or percentage in which a plant or a plant's organ is attacked and how much from the surface of the plant or

of the organ analyzed (leaf, fruit) is covered by the diseases under study.

The assessment of the surface under attack is done with the naked eye or with the magnifying glass, assessing the percentage occupied by spots or burns caused by the pathogenic agent. There can be noted the affection percentages, or grades can be given for each plant or organ attacked by the disease and/or by the pest. The usage of grades can make easier data summarization in a great extent. It can be used a scale with 6 degrees of intensity, as follows:

- Grade 0 no attack
- Grade 1 attack between 1 – 3%
- Grade 2 attack between 3 – 10%
- Grade 3 attack between 11 – 25%
- Grade 4 attack between 26 – 50%
- Grade 5 attack between 51 – 75%
- Grade 6 attack between 76 – 100%

After data's summarization, the attack's intensity is determined by the formula:

$$I\% = \frac{\sum (i \times f)}{n}$$

Where:

- I% – attack's intensity (in %);
- i – intensity according to the grade given to the organ or plant under attack;
- f – number of cases (plants, organs) attacked;
- n – number of plants attacked.

In our experience, there had been given grades from 1 to 6, separately, to the "flag" leaf and to the next leaf situated beneath it.

- The degree of attack is the expression of the extension of the seriousness of the attack onto the crop or onto the total number of plants at which we perform the observations. The value expression of DA is given by the relation:

$$D.A. (\%) = \frac{F \times I}{100}$$

In most cases, there is a negative correlation between the degree of attack of a pathogenic agent or pest and the quantitative and/or qualitative level of the production of a crop.

RESULTS AND DISCUSSIONS

The 2016 – 2017 agricultural year was favourable to the occurrence of the attack of the complex of pathogens specific to wheat, as compared to the previous years. The rainfalls had been frequent in April, being under the form of snow between 19th and 21st April.

In what concerns the dynamics of the occurrence of pathogens to wheat, we mention the following aspects, in what concerns the first experiment, where 2 phytosanitary treatments had been applied (first at straw's extension and the second at berries' filling):

- Wheat's mildew - *Blumeria (Erysiphe) graminis* f.sp. *tritici* had insignificantly affected the wheat (Andino variety) from the 2017 experiment, like in the previous year (D.A. < 1%).

- Septoriosi - *Septoria* sp. had moderately affected the Andino wheat variety, irregularly, being affected only the second leaf below the wheat ear, but in a smaller degree than at Glosa variety. Most of the times, the attack of this fungus on the second leaf was cumulated with the brown rust attack. Around 30% from the analysed plants of the untreated control variant had the second leaf affected by *Septoria* sp, aspect observed also at Glosa variety.

- Wheat's brown rust - *Puccinia recondita* f.sp. *tritici*, had affected the wheat (V4 – untreated control variant) in the limits comprised between the D.A. % - 25.8% at the "flag" leaf and the D.A.% -- 63.8 % at the second leaf beneath the wheat ear, cumulated with *Septoria* sp. These values had been observed on the date of June 16th, 2017.

As in the case of Glosa variety, attacks of stem's fusariosis and spikes' burns, *Giberella* sp. were not found.

When analysing the data from *table 1*, we observe that the degree of attack of the pathogens under monitoring, on each variant of treatment, is the following:

- V1 FALCON 460 EC 0.6 l/HA determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 10.6 % at the "flag" leaf and of 26.1% at the second leaf (cumulated with *Septoria* sp attack), so lower by 25.1% and respectively by 26.1 % as compared to the untreated control variant (V4).

- V2 MYSTIC 250 EC 0.5 l/HA has determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 0.8% at the "flag" leaf and of 30.5% at the second leaf (cumulated with the attack of *Septoria* sp), so lower by 25% and respectively by 30.3% as compared to the untreated control variant (V4).

- V3 TOPSIN 500 SC 1 l/HA+ BUMPER 250 CE 0.25 l/HA has determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 8.5% at the "flag" leaf and of 46.8% at the second leaf (cumulated with *Septoria* sp attack), so lower by 17.3% and respectively by 17% as compared to the untreated control variant (V4).

All differences in what concerns the degree of attack (D.A.%) are statistically ensured, according to *table 1*.

Out of the analysis of *table 3*, there can be observed also production differences as compared to the untreated control variant, V4, as follows:

- Variants: V1- FALCON 460 EC 0.6 l/HA and V2 MYSTIC 250 EC 0.5 l/HA have achieved larger productions than the untreated control variant (V4) by 0.45 t/ha and respectively

by 0.63 t/ha. The production differences are ensured statistically, significantly and respectively distinctly significant. V3 TOPSIN 500 SC 1 L/HA+ BUMPER 250 CE 0.25 L/HA has practically achieved an almost identical production (-0.14 t/ha) to V4.

In what concerns the dynamics of the occurrence of pathogenic agents' attacks on wheat, we mention the following aspects at the second experiment with Andino variety, where one single phytosanitary treatment was applied (at wheat plants' blooming), using the same fungicide products.

- The mildew -*Blumeria (Erysiphe) graminis* f.sp. *tritici* – had also insignificant values for this experiment (tabel 2).

- The values of the degree of attack of septoriosi and brown rust were the following:

- V1 FALCON 0.6 L/HA determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 10.6 % at the “flag” leaf and of 61.3% at the second leaf (cumulated with *Septoria* sp attack), so lower by 28.8% and respectively by 18.7 % as compared to the untreated control variant (V4).

- V2 MYSTIC 250 EC 0.5 L/HA has determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 10.2% at the “flag” leaf and of 60.0% at the second leaf (cumulated with the attack of *Septoria* sp), so lower by 29.2% and respectively by 20.0 % as compared to the untreated control variant (V4).

- V3 TOPSIN 500 SC 1 L/HA+ BUMPER 250 CE 0.25 L/HA has determined a degree of attack (D.A.%) of *Puccinia recondita* f.sp. *tritici* fungus of 25.9% at the “flag” leaf and of 85.3% at the second leaf (cumulated with *Septoria* sp attack), so lower by 13.5% and respectively by -1.3% as compared to the untreated control variant (V4).

The differences in what concerns the degree of attack (D.A.%) are statistically ensured, according to table 2, with one single exception (V3 – D.A.% at the second leaf).

The harvest differences as compared to the untreated control variant V4 can be observed by analyzing table 4, as follows:

- Variants: V1-FALCON 460 EC – 0.6 L/HA and V2 MYSTIC 250 EC 0.5 L/HA had obtained larger harvests than the untreated control sample (V4) by 1.128 t/ha and respectively, by 1.073 t/ha. The production differences are statistically ensured, significantly for both variants. V3 - TOPSIN 500 SC 1 L/HA+BUMPER 250 CE 0.25 L/HA has achieved practically an almost identical production (0.055 t/ha) to V4.

CONCLUSIONS

The 2016 – 2017 agricultural year had been favourable to the wheat harvest. 2016 – 2017 winter was rich in rainfalls, as well as the following spring. Between 19th and 21st April, they took the form of snow and slush. The attacks of the pathogenic agents had been very different, varying quite a lot from case to case, according to the cultivated technology and to the selected cultivar. Among the selected cultivars, there are large differences in what concerns the behaviour to the attack of some dangerous pathogenic agents, like those from *Puccinia*, *Septoria* and *Blumeria* species.

The observations made in the spring of the year 2017 on the wheat experiment – Andino variety, both the study with two phytosanitary treatments and the study with only one, have led to the following conclusions and recommendations:

1. The most dangerous pathogenic agent of wheat has proven to be *Puccinia recondita* f.sp. *tritici* fungus. Its attack has affected first of all the “flag” leaf, and second, the second leaf. However, the attack of wheat's brown rust on the untreated control variant was substantially lower at Andino variety, as compared to Glosa variety.

2. The second pathogenic agent which proved to be dangerous was *Septoria* sp. fungus. As a matter of fact, the plant's second leaf was affected, cumulatively, by the attack of *Puccinia recondita* f. sp. *tritici* and *Septoria* sp. fungi. Out of the total degree of attack (D.A.), at the second leaf, of the two pathogenic agents, the ratio was: *Puccinia recondita* f. sp. *tritici* 70% and *Septoria* sp. 30%, also observed at Glosa variety. However, we underline the fact that Andino variety was affected substantially less than Glosa by the attack of the fungi from *Septoria* variety.

3. Slight attacks of *Blumeria (Erysiphe) graminis* f.sp. *tritici* fungus which produces wheat's mildew were observed.

4. For a reliable protection of the wheat crop, in case of using Andino variety, we recommend the application of two treatments with different fungicide products in the years with rainy springs, belonging to the group containing one single active substance and which is cheaper, such as MYSTIC 250 EC product. In the conditions where in the year 2018 it is foreseen a price of around 0.65lei/ kg of wheat, choosing the fungicide product is most important from the price's point of view. For example, MYSTIC 250 EC product has a price of approximately 110 lei/l and 0.5 l/ha is applied, so the cost is 55 lei/ha. FALCON 460 EC product costs around 190 lei/l and 0.6-0.7 l/ha is applied, so the cost is of 114-

133 lei/ha. TOPSIN 500 SC product costs around 70 lei/l and 1 l/ha was applied in the experiment. BUMPER 250 SC product costs around 120 lei / l and 0.25 l/ha was applied in the experiment, so the cost is 30 lei/ha. So the cumulated cost per ha was 100 lei at V3.

The harvest increases were, at the study which included two phytosanitary treatments (table 3), of 0.45 t/ha at V1 (FALCON 460 EC – 0.6 l/ha) and of 0.63 t/ha at V2 (MYSTIC 250 EC - 0.5 l/ha). At a price of around 0.65 lei/kg wheat, the harvest increases at these two variants have brought, as compared to the untreated control variant, a plus value of 293 lei/ha respectively of 409 lei/ha. These increases justify, from economic point of view, the two treatments performed by using FALCON 460 EC product and especially, MYSTIC 250 EC product, which is cheaper than FALCON 460 CE.

The production increases were, at the study including one single phytosanitary treatment (table 4), of over 1 t/ha both at V1 FALCON 460 EC – 0.6 l/ha and at V2 MYSTIC 250 SC 0.5 l/ha. These two variants have brought, as compared to the untreated control variant, a plus value of 650 lei/ha. We underline the fact that these increases were obtained by applying one single treatment

applied at wheat plants' blooming. As a matter of fact, at Andino variety, MYSTIC 250 SC fungicide has proven to be very efficient especially at the second experiment, where only one single treatment was applied.

At both experiments of the study, V3 (TOPSIN 500 SC 1 l/ha + BUMPER 500 CE 0.25 l/ha) has obtained a production practically equal to the untreated control variant (V4). The application of this combination of products has proved to be unprofitable at Andino wheat variety, in the climatic conditions of 2017.

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