

Stem rust of perennial ryegrass: how effective are biocontrol and other alternative products against the disease?

WHAT ABOUT STEM RUST IN PERENNIAL RYEGRASS SEED PRODUCTION?

In France, seed production perennial ryegrass faced every year a stem rust pressure (caused by *Puccinia graminis*) that can negatively impact the yield. The management of stem rust is based on a biomonitoring observatory and the use of conventional phytosanitary products that are effective in maintaining an infestation level close to zero. The objective of our study was to identify one or more biocontrol or other alternative products with a protective efficiency close to that of conventional products.

WHAT DID WE PERFORMED?

For four years, two trials were set up on Fnams experimental stations, one in Troyes (10) and the other in Brain-sur-l'Authion (49), for a total of eight trials. Each trial was sown in a Fischer design with four replicates. The variety sown, susceptible to stem rust (2018 to 2020) and intermediate (2021), was the same on both sites. Plant resistance inducer products were applied preventively and when recontamination occurred. The other products were applied when the first pustules appeared. Stem rust symptoms were scored before each product application and 10-15 days later (scoring scale, Table I). The set of products evaluated over the four years is described in Table II. A principal component analysis (PCA) was performed to visualize the differences between the products. PCA analysis performed with R version 4.1.1.



Pustules of stem rust on perennial ryegrass stem

Table I - Disease scale of perennial ryegrass stem rust

Scale	Description of symptoms
0	No pustules visible after a few minutes of active searching
1	Presence of the first pustules by searching in the vegetation
2	Pustules well visible, quite easy to detect, no outbreak yet
3	Very frequent (generalized) pustules or 1st small outbreak(s)
4	Established outbreak(s) > 0.25 m ²
5	50% of the plot area is affected
6	60% of the plot area is affected
7	70% of the plot area is affected
8	80% of the plot area is affected
9	90% of the plot area is affected
10	100% of the plot area is affected

Table II - List of evaluated products and their mean number of applications over the four years trials

Products	Composition	Dose	Mean number of applications
FANDANGO S	Prothioconazole 100 g/l Fluoxastrobine 50 g/l	2 l/ha	2
VEG'LYS	Alliaceae extract	1 l/ha	3
LBG-01F34	Potassium phosphonate 755 g/l	4 l/ha	4
BC1	Cerevisane X	4 l/ha	5
MESSAGER	COS-OGA 12,5 g/l	2 l/ha	4
BC2	Yeast fragment extract	3 l/ha	6
BC3	Orange essential oil 60 g/l	7 l/ha	4

WHAT WAS THE OUTCOMES?

Stem rust pressure was variable between years and experimental sites. Scores ranged from 0 to 7. The variables ratings according to year and experimental site, used to perform the PCA, are all positively correlated (correlation coefficient between 0.86 and 0.97) on dimension 1 which explains ~75% of the variation between products (Figure 1). The negative coordinates of FANDANGO S (-5.7) and BC3 (-0.44) on this dimension 1 would indicate that they would be the only ones limiting disease development. This is consistent with field observations and disease score registered in Troyes in 2020 before perennial ryegrass seed harvest (Figure 2). Over all four years, the reference conventional product FANDANGO S showed the best protection results (in most cases a score of 0) with the lowest number of applications (2) on both sites. To a lesser extent, BC3 (mean rust score of 2.2) had fewer symptoms than the other biocontrol or other alternative treated plots. VEG'LYS and LBG-01F34 showed interesting protection results at the beginning of the attack, which were eroded with the increase of the stem rust pressure.

Figure 1 - Principal component analysis (PCA) of stem rust scores (4 years and 2 experimental sites) from plots of the evaluated products. Scores were performed according to the scale in Table I; the points in the PCA correspond to the evaluated products.

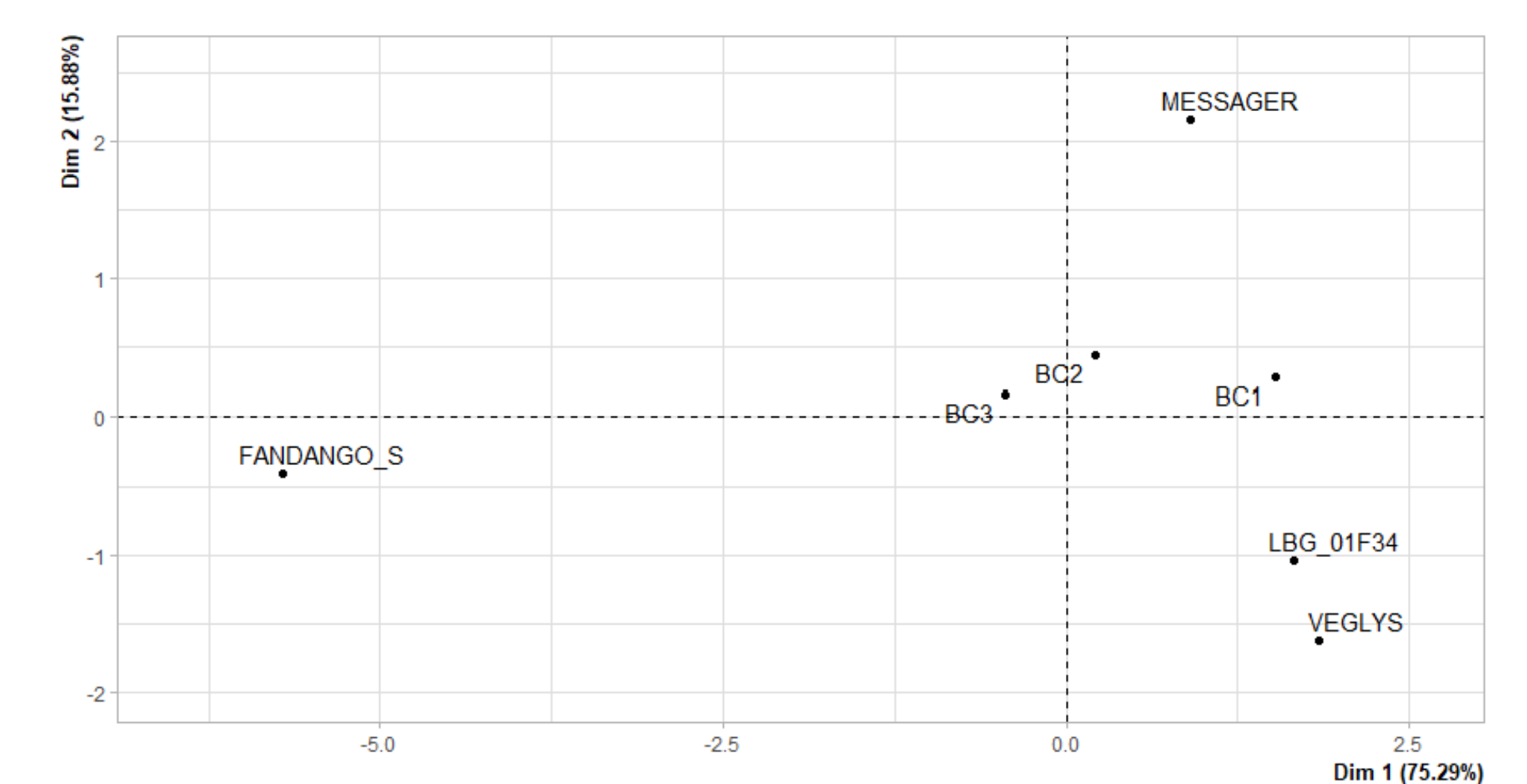
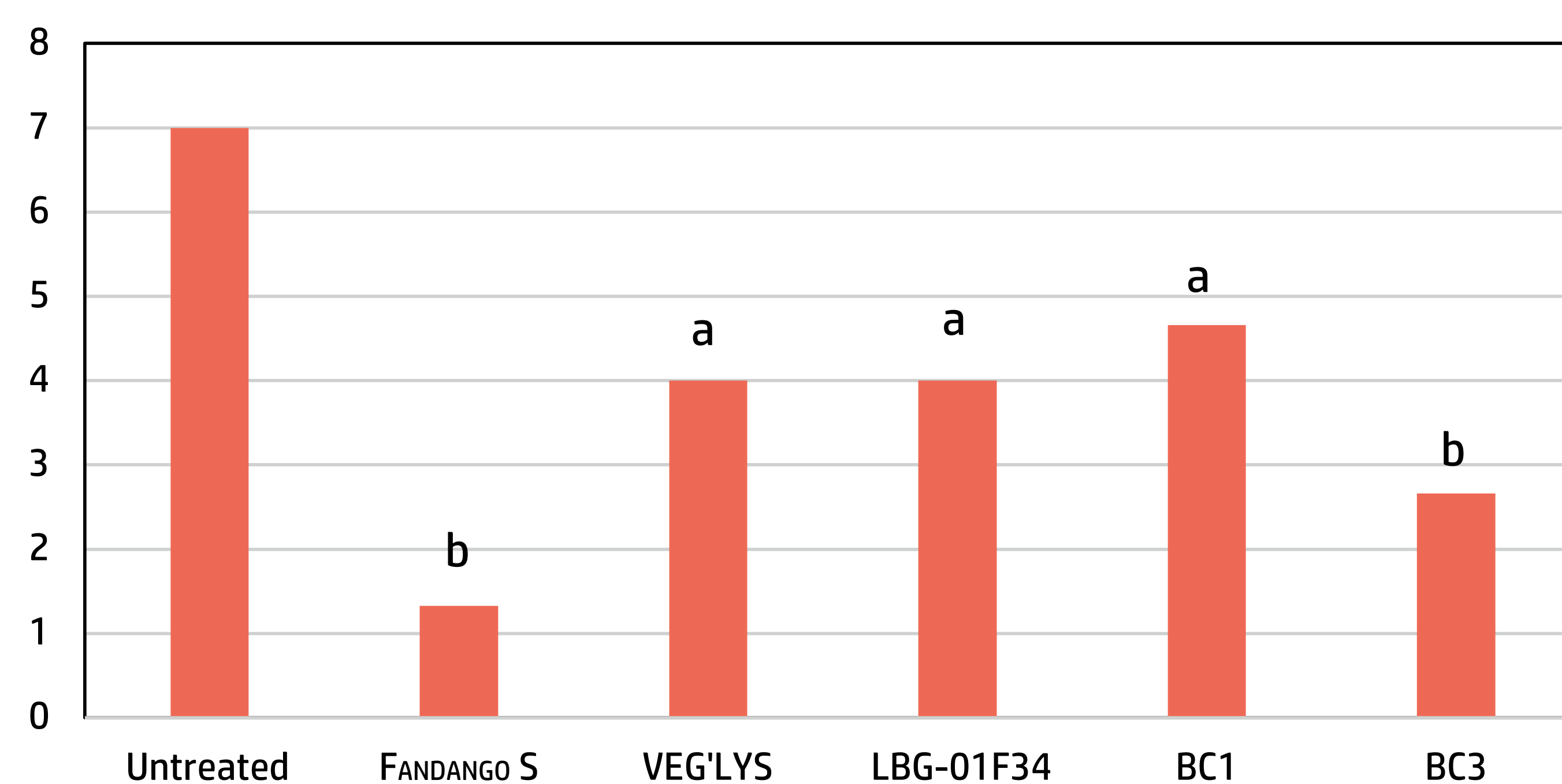


Figure 2 - results of stem rust evaluation in Troyes in 2020 after last application and before seed harvest. Letters "a and b" refers to statistical group. Untreated plot was included in statistical analysis according to the experimental design.



Plot totally affected by stem rust

TAKE HOME MESSAGE!

Although less effective than the reference FANDANGO S, the biocontrol product BC3 appears to be an interesting alternative. An experiment with modalities combining BC3 and the conventional reference (or other biocontrol products) is being considered to identify a program that would reduce the number of applications (and/or the rate) of BC3 and the conventional reference.

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