

## Importance of Metiram in the control of Potato late blight in Spain

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Technical Management APES

Phytophthora infestans is an Oomycete, that causes big losses in the production of potato therefore it's the main pathogen for this crop, threatening to food security. Late blight arrived to Europe around 1840 but recently new races have been described in Europe. They are more aggressive races related to the A2 mating type which seems to be more complex and may be displacing the original mating type A1. Actually in Spain the presence of mating type A2 is significant, in the study done by Alor Romero (2015) more than 50% in some areas were A2 mating type, and in the summary of data 2013-2016 done by Euroblight (European network for potato late blight management) was indicated that in Spain the distribution was 60% A2 types, 25% A1 and 15% other mating types. **These experts indicate that a high genetic diversity increases the risk of blight management problems - greater probability of pathogen types evolving virulence against novel host resistance genes and reduced sensitivity to specific fungicide active ingredients (Euroblight, 2017).**

Fungicides are a crucial component of late blight control, In Spain is the more critical disease and are applied a minimum of 4-6 times per season.

██████████ were first used to control late blight in the 1890s. By the 1960s, these had been largely superseded (except in organic production) by other broad spectrum contact fungicides such as dithiocarbamates. The introduction in the late 1970s of the ██████████ brought a new dimension to late blight control but was quickly followed by the development of ██████████ strains of the pathogen. In countries where phenylamides were applied as the sole active ingredient for late blight control, notably The Netherlands and the Republic of Ireland, this led in 1980 to a complete failure of disease control with concomitant crop losses. **This experience highlights the need for measures to minimize the risk of resistance development.** Actually ██████████ are now only available as co-formulations with fungicides that have different modes of action (e.g. ██████████), numbers of applications are limited and they must be applied preventatively.

This strategy was successful until the appearance of the aggressive [REDACTED] resistant 13\_A2 (Blue 13) genotype of the pathogen in the early 2000s. While [REDACTED] may still be applied as components in late blight control programs, a wide range of fungicides with different modes of action is now approved and widely used for late blight control. (FRAG-UK, 2018)

FRAC classifies *P. infestans* as a high-risk pathogen for fungicides targeting the RNA 2 polymerase (*viz.* the phenylamides), but classifies it as medium risk for all other modes of action. Resistance has been identified to some of the other fungicide groups used for late blight control (e.g. [REDACTED]), but only in pathogens other than *P. infestans*. However, in the past 10 years, genotypes of *P. infestans* associated with reduced effectiveness of fluazinam against late blight have been reported in mainland Europe. The role of fluazinam in late blight control programmed therefore needs to be re-considered.

Actually we know that this disease is very aggressive and resistant strains can be develop relative easily. Integrated management for the control of the disease is a must, based in different aspects:

- **Cultivar choice.**
- **Destruction of all piles of outgrade potatoes** to reduce the source of early inoculum.
- **Use good quality seed.**
- **Start the applications as soon as the conditions are good to disease development.**
- **Adjust the spray interval** to the evolution of the disease. Not over extend the interval.
- **Avoid always erradicant applications.**
- **Make full use of fungicides with different modes of action:** avoid over-reliance on a single fungicide group, use co-formulations or tank mixes of different active ingredients, target specific products to appropriate growth stages and **include multi-site fungicides e.g. Metiram, Mancozeb...**
- **Protect until the end of the season:** maintain protection of the foliage with fungicides until the foliage is dead. Where there is a risk of tuber infection, complete the spray program with fungicides with tuber blight activity and different modes of action, apply a fungicide with the desiccant (check product labels for approved tank-mixes) and make further fungicide applications until the haulm is dead.

All these practices are important to control the disease but adequate fungicides use (product, spray interval, time of application...) is key in late blight control. In Spain there are many products available but multisite active ingredients are an especially important segment.

In 2018 FRAC international (Fungicide Resistance Action Committee) published a document about the **high Importance of multisite fungicides in managing pathogen resistance**. The Use of multisite fungicides (see FRAC Group M) in spray programs in crops with multiple sprays such as fruits, vegetables or potatoes is really important. Due to their mode of action, multisite fungicides are considered as a low resistance risk group. **Therefore, they offer the possibility for use as mixing partners or alternating with single site and other medium to high resistance risk fungicides**. Over the past decades, no cases of field resistance against multisites have been reported. (FRAC, 2018).

There are clear benefits to recommending multi-site fungicides in spray programs:

- **Multisite fungicides display a low risk to develop resistance and are effective mixing/alternating partners for medium to high risk fungicides.**
- **Beyond protecting and prolonging the lifespan of highly effective medium to high resistance risk fungicides**, multisite fungicides provide added levels and spectrum of disease control. With this they can also support the single sites to be even more efficient.
- **Multisite fungicides are considered a valuable tool to manage resistance** by preventing or delaying its development to many pathogens in many crops.

**Restricting the use of multisite fungicides from use in important crops could result in faster development of resistance to single site mode of action fungicides. This in turn could lead to epidemic disease development, serious crop losses, and finally the loss of highly effective fungicides for a sustainable disease management.**

Multi-site fungicides such as Metiram remain important in solo products and also effective mixture partners in anti-resistance strategies.

The UK research institute ADAS published in 2017 a very interesting research work about the importance of multisite fungicides to avoid the resistance in potato late blight. In this study was remarked that if this kind of fungicides disappear from the market resistance to the rest of mode of action will appear relative soon, in 3-4 years to [REDACTED] or [REDACTED], or in 7-8 years to [REDACTED]. In this study the disappearance of this multisites also was evaluated from economical point of view, indicating that in Spain can mean around -5% of profitability loss for the farmer (Wynn et al, 2017).

## Situation in Spain about multisite role in late blight control in potato

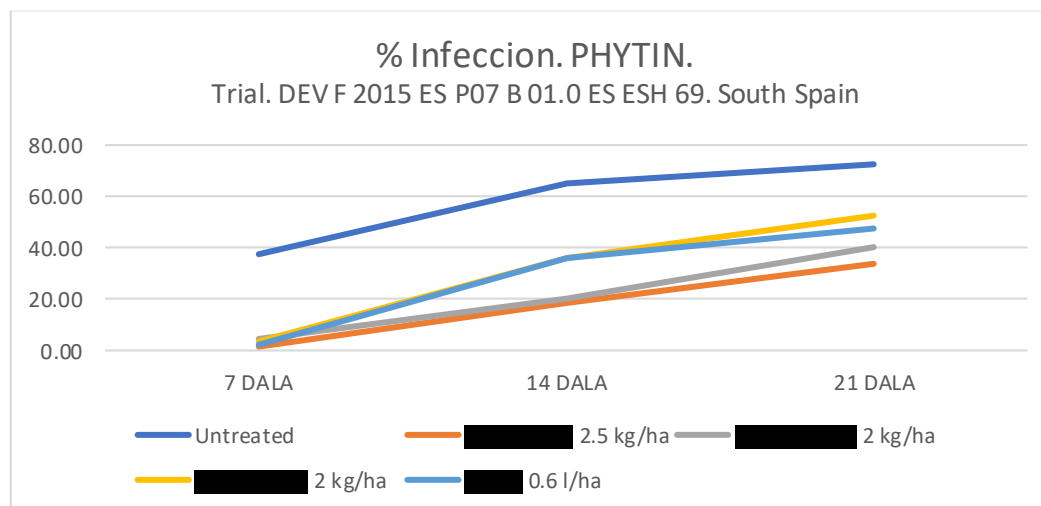
Actually in Spain there are register a good number of products with many different modes of action. But its important remark that only are register four multisite active ingredients:

- [REDACTED]: Multisite part of the chloronitriles. Medium efficacy expected. Recently is confirmed that will be out of the market very soon due to regulatory restrictions.
- [REDACTED]: Inorganic fungicide with medium – low efficacy. Most probably the dose rate authorized per year will be reduced drastically in the following years,
- [REDACTED]: Part of the dithiocarbamates. Have still good efficacy. Is under strong regulatory pressure.
- [REDACTED]: Also part of the dithiocarbamates. Has in general good efficacy. Also is under regulatory pressure.

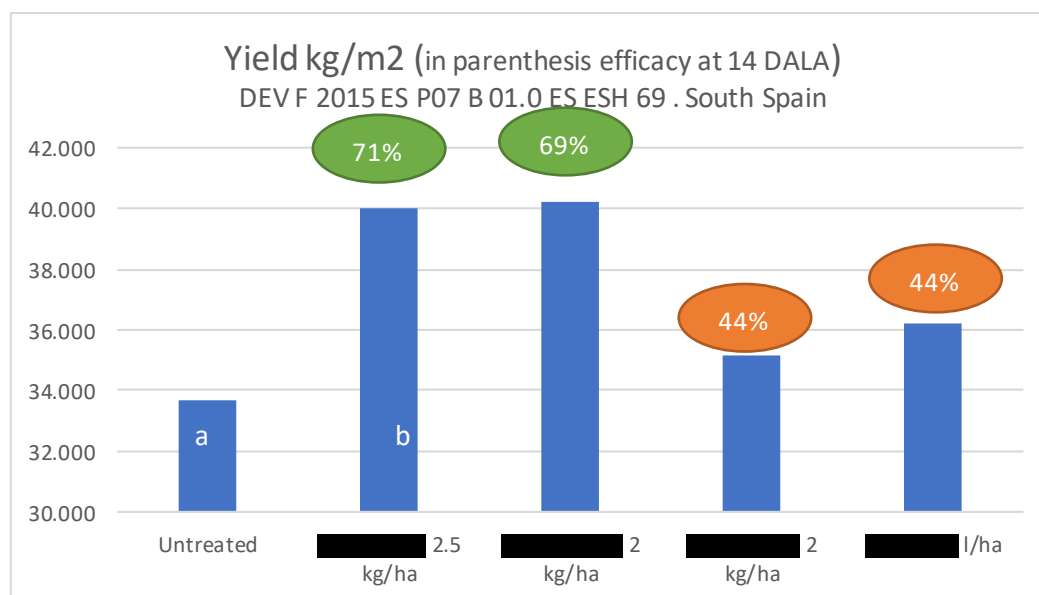
The segment of the multisite is under high risk in Spain, being possible that in some years the availability of this crucial tool for the potato farmer can be not available or very reduced.

Inside the segment of multisites Metiram is key in potato production in Spain due to its efficacy and long lasting efficacy. In trials done in south Spain in the last years this have been checked. In the Figure 1 is showed the % of infection by *Phytophthora infestans* for the different treatments at 7, 14 and 21 days after last application, comparing top new generation fungicides like [REDACTED] or [REDACTED] with products with multisite activity like [REDACTED] or Polyram (Metiram solo). In the Figure 2 are compared the same treatments focused on yield and also is indicated the efficacy at 14 days after last application. In both figures is possible to see that Metiram has a good efficacy in a high disease level situation, comparable to [REDACTED] and better than [REDACTED]. The high efficacy of the better treatments had a clear impact on yield (Figure 2), where we can see around +10% more yield when Polyram © (Meriram) or [REDACTED] were used.

**Figure 1. Comparison of different fungicides to control late blight in potato. Infection (%) by PHYTIN at 7, 14 and 21 days after last application. Trial DEV F 2015 ES P07 B 01.0 ES ESH 69**

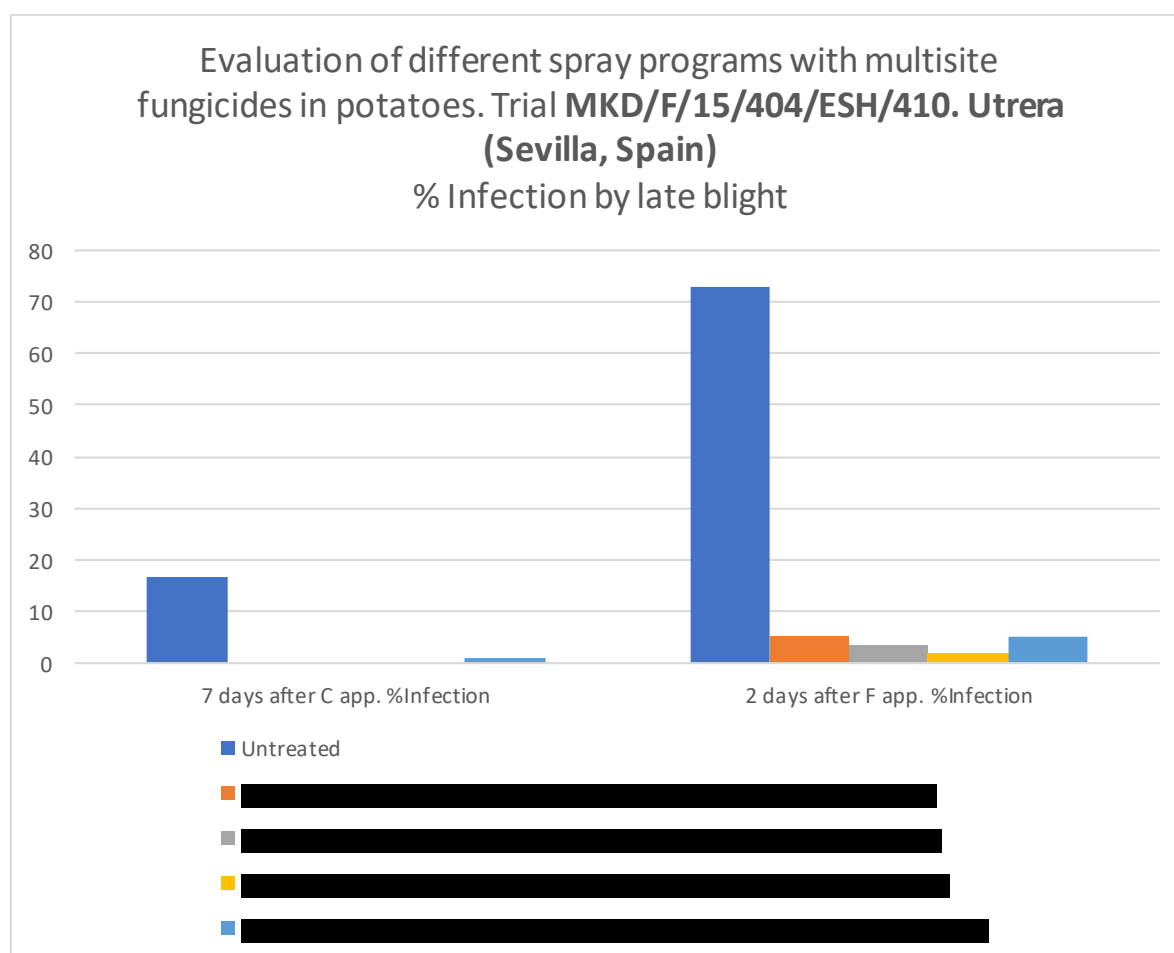


**Figure 2. Comparison of different fungicides to control late blight in potato. Yield and % efficacy (14 DALA). Trial DEV F 2015 ES P07 B 01.0 ES ESH 69**



In other trial done in Sevilla area (Figure 3) were compared different spray programs where are mixed multisites ( ) and “single sites” fungicides. The analysis of the data show that the spray programs that contains multi-sites have a similar efficacy that the ones based in more specific fungicides. We can conclude that **multisites have a very good efficacy with the advantage of avoiding resistance appearance, keeping in this way the efficacy for the future of the others mode of action.**

Figure 3. Comparison of different spray programs to control late blight in potato. % infection. Trial **MKD/F/15/404/ESH/410**.



## Summary & Conclusions

Multisite fungicides and specifically Metiram are important in the control of potato late blight because:

- ➔ Late blight is the more dangerous disease for potatoes in Spain (and in all Europe)
- ➔ Late blight is very aggressive and has a high risk of developing resistance
- ➔ In Spain it is necessary a strategy of resistance management to control this disease.
- ➔ Fungicides are one of the main tools to control this disease, and multisites are the key group in order to reduce the risk of resistance and keep in this way the efficacy for the future of the others very specific modes of action.
- ➔ In Spain are available a very small amount of multisite fungicides and many of them can be out of the market soon.
- ➔ Metiram is one of the multisites registered in Spain with higher efficacy in potato late blight.
- ➔ Metiram is a very important tool for the Spanish farmer to control in a sustainable way potato late blight and maintain the profitability of the crop.

## Bibliography

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