

Initium® based products for the control of *Phytophthora* *infestans* in potatoes

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SUMMARY

Initium is an innovative fungicide belonging to a new class of chemistry, the triazolo-pyrimidylamines. In order to maintain this new class of chemistry and in order to ensure a sustainable use in different crops, Initium will be launched only in combination with other active ingredients. Initium containing products will be positioned in preventive spray applications against late blight (*Phytophthora infestans*) in potatoes and against downy mildews in a wide range of speciality crops.

In potatoes two Initium containing products will be launched in North Europe. One product is the combination of Initium with the local systemic compound dimethomorph. This combination controls effectively all relevant development stages of *Phytophthora infestans*, causing potato late blight on leaves and tubers.

In the second new Initium containing product, Initium and Mancozeb were combined in a synergistic way to a premium preventive product. In addition to *Phytophthora infestans*, Initium+mancozeb provides a basic *Alternaria spp.* control due to the activity of mancozeb.

Many trials conducted by BASF, EuroBlight and official advisors in the European countries during the last years demonstrated an excellent performance of Initium+dimethomorph and Initium+mancozeb on *Phytophthora infestans* in potatoes at the same level of the best market standards.

First registrations of Initium containing products are available in Rumania, The Netherlands and The United Kingdom. The worldwide registration initiatives will continue from 2010 onwards and further registrations in important potato markets are expected.

INTRODUCTION

In all countries with relevant potato production *Phytophthora infestans* causes severe yield losses. Therefore *Phytophthora infestans* is deemed to be the most dangerous potato disease (Radtke & Rieckmann, 1990). For the control of *Phytophthora infestans* BASF has developed the active ingredient Initium. Initium belongs to a new chemical class called the triazolo-pyrimidylamines. More details about this new compound and its unique properties can be found in the paper "Initium: a new fungicidal active ingredient for the control of Oomycetes", available in this proceedings.

In order to avoid or slow down the development of resistance to Initium in target pathogens, and in order to ensure a sustainable use in all crops, Initium will only be launched in combinations with other compounds.

The aim of this paper is to give an overview about the product profiles and the mode of action. Furthermore the efficacy against leaf and tuber blight and the rainfastness characteristics of the products will be presented.

PRODUCT PROFILES

For the potato markets in North Europe, two Initium containing products will be launched.

Initium+dimethomorph is a combination product containing the contact fungicide Initium and the local systemic active ingredient dimethomorph. The product is formulated as a 525 g/l suspension concentrate (SC). The target rate against *Phytophthora infestans* in potatoes is 0.8 l/ha in a preventive application scheme. Early blight (*Alternaria* spp.) is not controlled by Initium+dimethomorph. First registrations of Initium+dimethomorph are available in Rumania (trade name: Orvego[®]), The Netherlands (trade name: Orvego[®]) and The United Kingdom (trade name: Resplend[®], Zampro DM[®]). Further registrations are expected from 2010 onwards.

Initium+mancozeb is a combination product containing the contact fungicide Initium and the well known contact fungicide mancozeb. The product is formulated as a 560 g/kg water dispersible granule (WG). The target rate against *Phytophthora infestans* is 2.5 kg/ha in a preventive application scheme. At this target rate the mancozeb amount is high enough to ensure a basic control of *Alternaria* spp. The first registration of Initium+mancozeb is available in The United Kingdom (trade name: Decabane[®]). Further registrations are expected from 2010 onwards.

The product details are summarized in Table 1.

Table 1: Product profiles of Initium+dimethomorph and Initium+mancozeb

Active ingredients	Initium + dimethomorph	Initium + mancozeb
Mode of action	Complex III inhibitor + Inhibitor of phospholipids biosynthesis and interference with cell wall formation	Complex III inhibitor + Multi-site inhibitor
Formulation	300 + 225 g/l SC	80 + 480 g/kg WG
Target dose rate (potato)*	0.8 l/ha (= 240 + 180 gai/ha)	2.5 kg/ha (= 200 + 1200 gai/ha)
Target disease (potato)*	<i>Phytophthora infestans</i>	<i>Phytophthora infestans</i> , (<i>Alternaria</i> spp.)
First registration	2009 (RO) 2010 (NL, UK)	2010 (UK)
Further target crops*	Different vegetables, hops	Leek, Onions
Futher target diseases*	Late blight, downy mildews	Late blight, downy mildews

* General information; country-specific labels must be considered

MODE OF ACTION

The combination Initium+dimethomorph ensures that all infectious stages of the late blight life cycle can be controlled: By inhibiting complex III, Initium impairs the electron transport in the respiratory chain of the pathogen, thus making it unable to generate the energy required for keeping the organism alive. With this mode of action Initium is a highly effective inhibitor of zoospore formation and release as well as zoospore mobility and germination. For more details about the mode of action of Initium see the previous paper in this proceedings entitled “Initium: a new fungicidal active ingredient for the control of Oomycetes”. Dimethomorph is a local systemic fungicide that inhibits the phospholipid biosynthesis and the cell wall synthesis of target pathogens. By inhibiting the formation of the Oomycete fungal cell wall, dimethomorph provides a good protectant and antisporulant activity.

In Initium+mancozeb the two contact fungicides are combined in a synergistic way. The Initium mode of action is ideally combined with the mode of action of mancozeb, which inactivates the sulfhydryl groups of amino acids and enzymes of fungal cells. This results in the disruption of lipid metabolism, respiration and production of ATP. As a non-systemic, multi-site fungicide mancozeb is able to provide an excellent efficacy at the early infectious stages of the *Phytophthora infestans* lifecycle.

The efficacy of Initium+dimethomorph and Initium+mancozeb at different development stages of *Phytophthora infestans* lifecycle are illustrated in Figure 1.

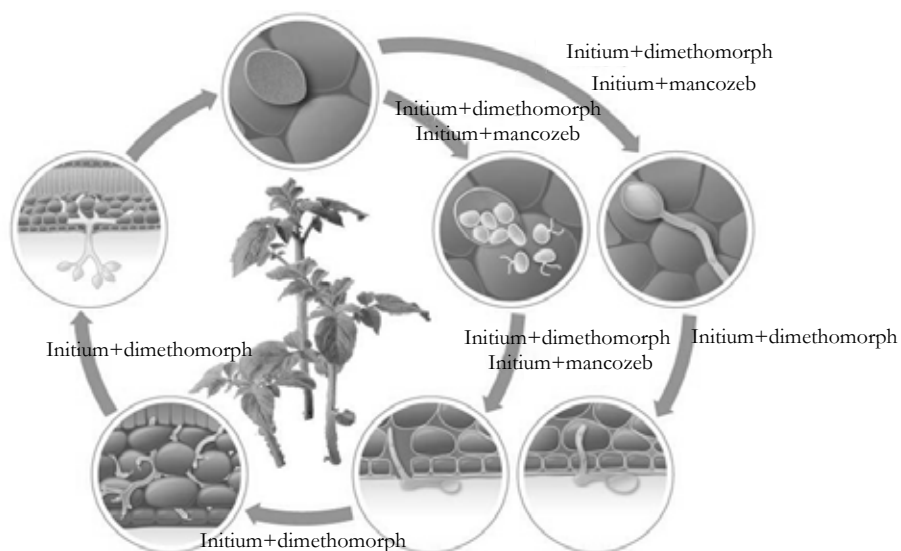


Figure 1: Efficacy of Initium+dimethomorph and Initium+mancozeb at different stages of the *Phytophthora infestans* lifecycle.

Initium+dimethomorph and Initium+mancozeb control effectively metalaxyl-resistant *Phytophthora* isolates, as neither Initium, mancozeb nor dimethomorph are cross-resistant to phenylamides (metalaxyl). Furthermore several lab and field studies indicate that Initium+dimethomorph and Initium+mancozeb provide reliable efficacy against A1 and A2 mating types of *Phytophthora infestans*, including the most aggressive strains, e.g. “Blue 13”.

RESISTANCE MANAGEMENT

In order to ensure a sustainable use, Initium will only be sold in combination with other active ingredients. This decision ensures a built-in resistance management. Furthermore, the registered application number of Initium products will be limited. As routine activities, Initium+dimethomorph and Initium+mancozeb were already included in the past in existing resistance monitoring programs. These proactive measurements will ensure an efficient resistance management of Initium.

To use and maintain the full activity of Initium containing products it is nevertheless essential that all applications should be done in a preventive manner following the recommendations on the product label.

EFFICACY AGAINST *PHYTOPHTHORA INFESTANS* ON LEAVES

During the development phase of Initium+dimethomorph and Initium+mancozeb numerous lab and field studies were performed worldwide from 2004 onwards in order to evaluate the efficacy of Initium+dimethomorph and Initium+mancozeb against *Phytophthora infestans*.

Methods and Materials

The field trials were conducted in accordance to GEP and EPPO guidelines (EPPO PP 1/2, EPPO PP 1/181). Trials were designed with a randomized block design including 4 replications. Depending on the local conditions the untreated plots were either included as randomized plots in the field or as untreated boarder rows between the treated plots. The size of the blocks varied from 10 to 200 m². All trials were sprayed at the beginning of attack, either using special small plot tractor spray equipment or a knapsack sprayer. Treatments were applied in 150 - 600 liters water/ha. A visual assessment of the intensity of attack (in %) was made for each plot.

Figure 2 and 3 demonstrate the very good efficacy of Initium+dimethomorph and Initium+mancozeb in comparison to leading market standards. In this kind of preventive trials both Initium+dimethomorph and Initium+mancozeb are comparable or slightly better than the leading market standards. The standard deviations of Initium+dimethomorph and Initium+mancozeb are lower in comparison to those of the most reference products, indicating less variation in the performance of Initium+dimethomorph and Initium+mancozeb compared to the standards.

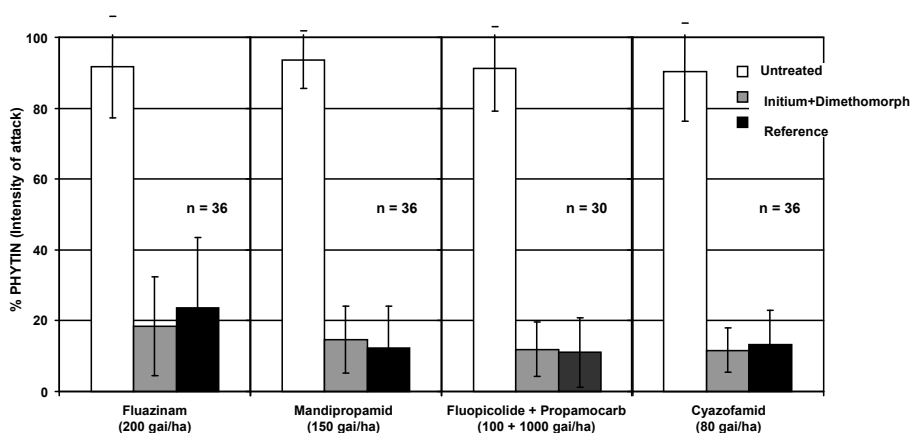


Figure 2: Efficacy of Initium+dimethomorph against *Phytophthora infestans* in comparison to other active ingredients

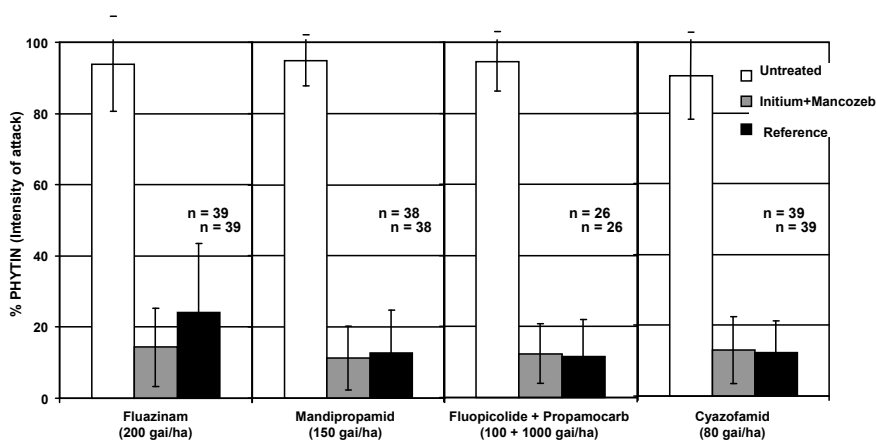


Figure 3: Efficacy of Initium+mancozeb against *Phytophthora infestans* in comparison to other active ingredients

EFFICACY AGAINST *PHYTOPHTHORA INFESTANS* ON TUBERS

Both BASF field trials and EuroBlight trials demonstrated that Initium+dimethomorph and Initium+mancozeb can effectively reduce the *Phytophthora infestans* attack on tubers. Looking closer to the activity of Initium and its combination partners, this effect was expected. Due to its good performance against *Phytophthora infestans* on leaves, Initium+dimethomorph and Initium+mancozeb reduce this important part of the inoculum source for *Phytophthora infestans* on tubers. Furthermore, Initium causes zoospore bursting and significantly fewer viable zoospores can therefore infect the tubers.

In 2010 additional trials will be conducted by the EuroBlight group and by BASF to create additional field data to further document the field performance of the new products.

RAINFASTNESS

Based on the high affinity of Initium for the wax layer of the leaf epidermis, it was assumed that Initium containing products have very good rainfastness properties. This assumption was confirmed in several lab and field trials on different crops.

One of these trials, a two factorial field trial conducted in 2008 by the BASF field research team in Limburgerhof is included in this paper. The trial was carried out according to the EuroBlight rainfastness protocol (Schepers *et al.*, 2007). It was located in Böhl in the Palatinate area in Germany and was conducted under GEP conditions. The variety Bintje was used as it is highly susceptible to *Phytophthora infestans*. Within the 4 replications the plots were randomly distributed. During the period of high late blight risk the trial was applied 4 times with an interval of 6-14 days. For all treatments five different irrigation intensities were tested after each application: no irrigation, 20 mm irrigation 1 hour after application, 20 mm irrigation 3 hours after application, 40 mm irrigation 1 hour after application and 40 mm irrigation 3 hours after application.

The results of this trial prove that both products, Initium+dimethomorph as well as Initium+mancozeb, have excellent rainfastness properties. Both products are significantly better than the rainfastness properties of fluopicolide + propamocarb and comparable or only slightly weaker than the rainfastness

properties of cyazofamid and mandipropamid.

Figure 4 illustrates the results of the assessment done 7 days after the last application.

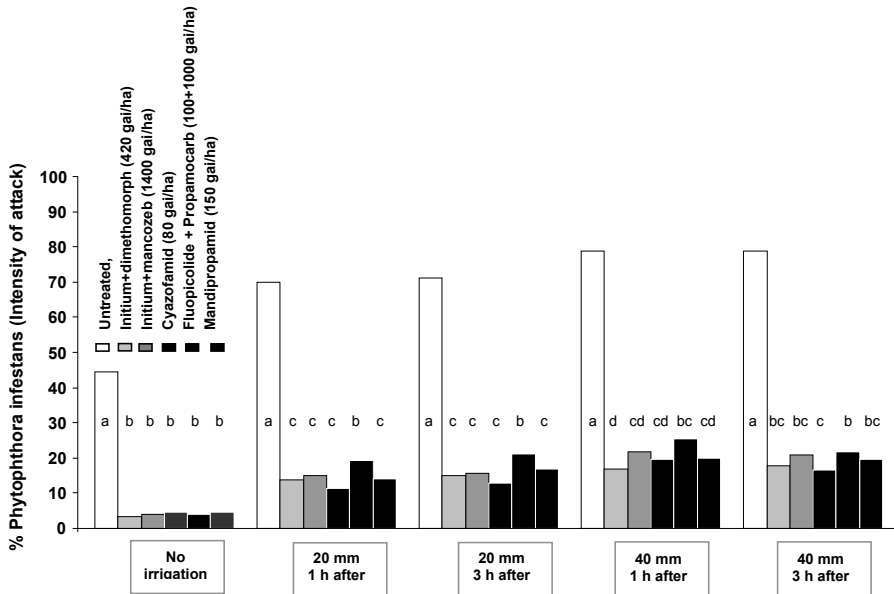


Figure 4: Efficacy of *Initium+dimethomorph* and *Initium+mancozeb* against *Phytophthora infestans* in comparison to standard products after different intensities of rain (Statistical analysis: SNK-test after arcsin-transformation, $\alpha=0.05$, statistics are within one rain level)

CONCLUSIONS

Belonging to the new chemical class of triazolo-pyrimidylamines, *Initium* will ensure efficient *Phytophthora infestans* control even under high disease pressure and heterogeneous *Phytophthora* field populations. With the combination products *Initium+dimethomorph* and *Initium+mancozeb*, BASF has developed two products containing the new active ingredient *Initium*. Many trials conducted by BASF, EuroBlight and official advisors in the European countries demonstrated an excellent performance of *Initium+dimethomorph* and *Initium+mancozeb* on *Phytophthora infestans* at the same level of the best market standards. Worldwide registration initiatives ensure that *Initium+dimethomorph* and *Initium+mancozeb* will support potato growers in their efforts towards an efficient and sustainable disease management of *Phytophthora infestans*.

ACKNOWLEDGMENT

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