

The influence of crop rotation and cultivar resistance on the onset of early blight (*Alternaria solani*)

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INTRODUCTION

- Early blight (EB) (*Alternaria solani*) is an important disease in potato production worldwide.
- Under favourable conditions EB can cause significant yield losses ranging between 20-50% [1].
- The influence of the crop rotation and cultivar resistance on the onset EB has not been extensively studied.

Objectives

- To determine the influence of cropping history and cultivar resistance on the occurrence of EB.

Hypotheses

1. At least two years without potato will delay the onset of EB.
2. Continuous potato on the same field will lead to earlier attacks as fields that were planted with potato in the previous year, regardless of whether potato was grown continuously or intermittently.
3. Cultivar resistance has no influence on the onset of EB.

Materials & Methods

Experimental design & Cultural practices

- The field experiments were conducted during the 2016 growing season at Flakkebjerg Research Center, Denmark.
- The experiment was designed as a Randomized Complete Block Design (RCBD) arranged as a split plot design. The main plot factor was 6 fields with different cropping histories (Table 1).
- The sub-plot factors were 3 potato cultivars (Agata, Sava and Kuras) with different levels of susceptibility to early blight.
- The cultivars Agata, Sava, and Kuras have been classified as very susceptible, moderately slow blighting and susceptible and slow blighting respectively (Abuley, Unpublished data).
- Certified seed tubers of the cultivars were planted on 11th May, 2016.
- Late blight (*Phytophthora infestans*) was controlled with 150g/ha-1 mandipropamid (applied as Revus 250g, mandipropamid L-1 SC, Syngenta)

Assessment

- Assessment of the potato plants in the plots for typical early blight symptoms started from 50% emergence of the potatoes.
- Assessments continued every three days until early blight lesions were observed.
- The onset of EB on the potatoes was expressed as days after emergence (DAE).

Statistical analyses

- To test for the effect of cultivar, field and their interaction on the onset of early blight, the onset of early blight expressed in DAE was tested using a permutation test.
- The permutation test was performed using the "aovp" function from the "ImPerm" package [2] in R statistical language [3].
- Post-hoc analysis using Tukey's honest significance difference (HSD) ($p=0.05$)

REFERENCES

- [1] VAN DER WAALS, J. E., KORSTEN, L. & AVELING, T. A. S. 2001. A review of early blight of potato. African plant protection, 7, 91-102
- [2] WHEELER, B. & TORCHIANO, M. 2016. ImPerm: Permutation test for Linear Models. R package version 2.1.0. ed.
- [3] R core team 2016. R: A Language and Environment for Statistical Computing. 3.1.1 ed. Vienna, Austria.

Table 1. Cropping history of field fields used

| Field | Cropping history ^a | Previous Crop ^b | Early Blight ^c |
|-------|-------------------------------|----------------------------|---------------------------|
| P0 | No potatoes > 5 years | Fallow | None |
| P1 | 2015 (0) | Potato | High |
| P2 | 2014 (1) | Barley | High |
| P3 | 2013 (2) | Barley | High |
| P4 | 2012 (3) | Barley | High |
| P5 | Continuous rotation (0) | Potato | Low |

^athe years represent the last time potato was grown the field and the number of years without potato in parenthesis, ^bthe crops that were grown during the potato free years, ^clevel of early blight attack at the last time potato was grown on the field: >50% foliar attack = high, 6-49% foliar attack = moderate, ≤5% foliar attack = low, none = no record of early blight.

Results & Discussion

- There was no significant effect of variety on the onset of EB ($p=0.347$).
- There was no significant effect of Cultivar X field interaction ($p=0.867$).
- The effect of the rotation field was significant on the onset of EB ($p<0.001$).
- EB occurred earlier when the interval between subsequent potatoes was less than two years (Figure 1).
- The earliest time for symptoms to show was on the field that was just preceded by potatoes in 2015 (P1) (Figure 1).
- Even though it was expected that EB will occur earlier on the continuous rotation field (P5), the result in Figure 1 showed that EB occurred later on P5 than on the P1 field.
- This could be due to the low attack of EB on the P5 fields in previous years (Table 1).
- For the fields that had no potato for two or more years EB occurred at the same time as the fields without potato for long time (Figure 1).

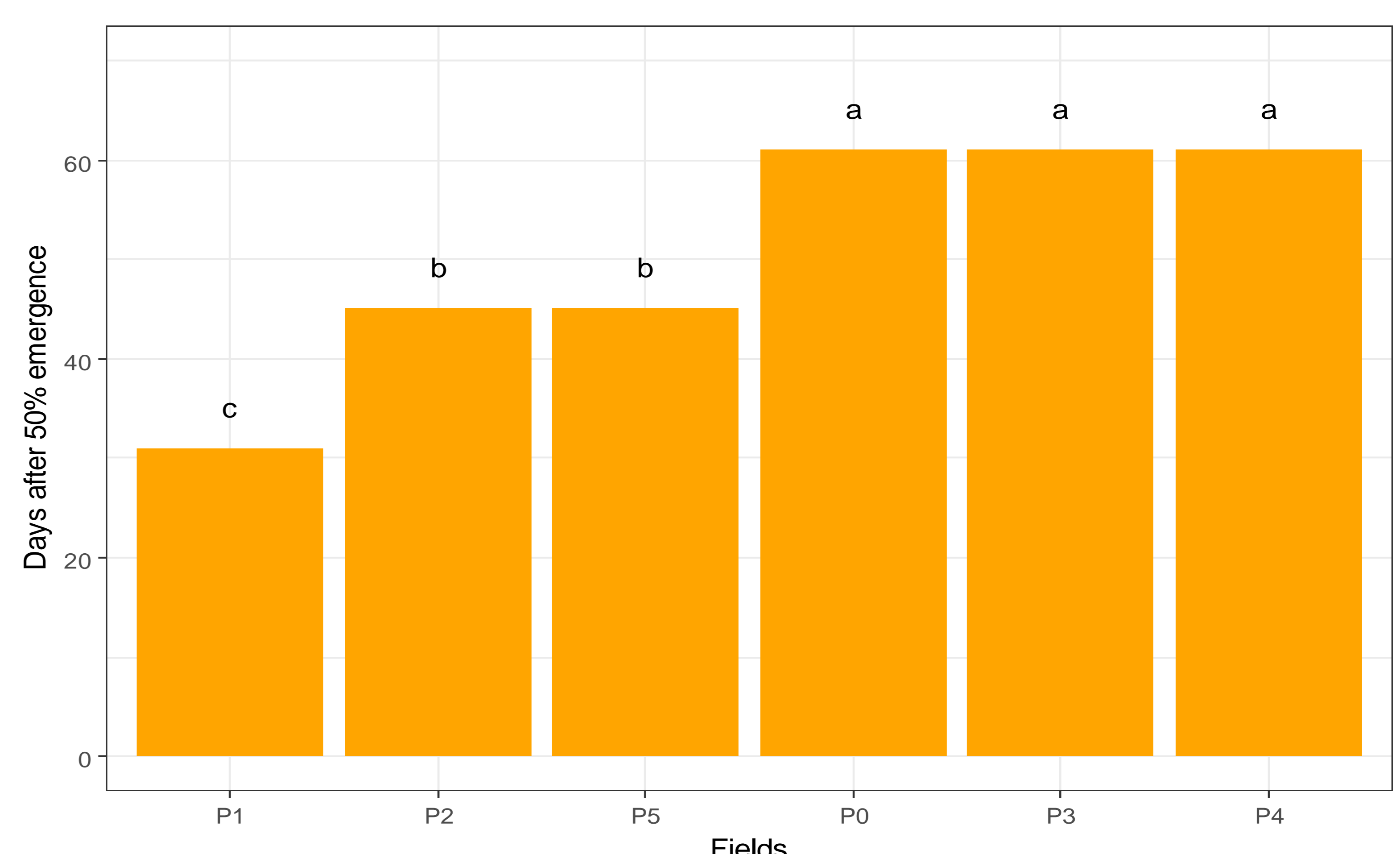


Figure 1. Onset of early blight on fields with different histories with potato. Bars followed by the same letters are not significantly different (Tukey HSD, $p=0.05$).

Conclusion

- We can conclude the choice of variety was not important in delaying the onset of early blight.
- At least 2 years potato free was enough to markedly delay the onset of early blight.
- Planting potato after potato increased the chance of early onset of EB but this was also dependent on the previous severity of EB. Thus for fields with low incidence of early blight, crop rotation may be of little significance.