Efficacy of Armicarb (potassium bicarbonate) against scab and sooty blotch on apples

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***Abstract* - A novel formulation of potassium bicarbonate (Armicarb) was evaluated in 2004 and 2005 as agent against apple scab and sooty blotch in several field trials. Armicarb controlled scab equally well as the reference treatments sulphur and copper. Armicarb showed also excellent activity against sooty blotch. However, potential side-effects such as lenticell spot development need further investigation. At present, potassium bicarbonate is considered by the Swiss registration authorities as non-toxic to humans and in consequence, no residue levels have been specified. Armicarb has very interesting properties as a plant protection agent and its composition and risk profile are expected to fulfil the IFOAM standards for acceptance of novel plant protection agents to a very large extent.[1]**

Introduction

Apple scab and sooty blotch may cause major losses in European organic apple orchards. The control of both diseases in scab-susceptible cultivars as well as of sooty blotch in scab-resistant is often difficult and not sufficiently successful. Scab is usually controlled in Switzerland by copper and/or acidified clay treatments before flowering, and sulphur treatments afterwards. These substances have well known disadvantages which include accumulation in soil (copper), inadequate scab control at low temperatures and deleterious effects on beneficials (sulphur). Therefore, alternatives to copper and sulphur are currently studied in national and international projects (e.g. Köhl et al., 2004).

Sooty blotch development is suppressed by applications of coconut soap (Fuchs et al., 2002). However, coconut soap treatments are sometimes insufficient close to harvest and, as a side-effect, increase of Gloeosporium in treated apples has been observed.

In this study, we investigated the effect of the novel commercial formulation Armicarb (potassium bicarbonate) (Anonymous, 2005a; 2005b) on scab and sooty blotch under field conditions (Tamm et al, 2006).

Materials and Methods

To evaluate scab control, two experiments were conducted in 2004 and 2005 in Frick (cv. Rubinette) in an experimental orchard, and one trial was conducted in 2005 in a commercial orchard in Prangins (cv. Golden Delicious). Applications were made before rain events at weekly intervals and adjusted to climatic conditions.

Experiments on sooty blotch control were conducted in 2004 and 2005 in a commercial orchard in Pfyn (cvs. Resista & Topaz 2004, cv. Topaz 2005)). The trees were sprayed with knapsack sprayers every two weeks according to weather conditions.

All experiments were conducted according to EPPO guidelines.

Results

Apple scab trials: Armicarb provided good control against leaf scab in all three trials (Fig. 1, 2). In 2004, the Armicarb concentration was lowered in Frick after the first five sprays from the initial 1% to 0.5% since severe stunting of trees was observed at this concentration. However, at 0.5% no stunting and no other phytotoxicity symptoms were observed in any trial. Armicarb provided excellent spread on the leaf surface and left no visible residues.

Sooty blotch trials: Armicarb provided excellent protection against sooty blotch at a dose of 0.5% in both years (Fig. 3, 4). Biofa Cocana RF, which is the current standard in organic apple growing, controlled sooty blotch also well at 1%. Inulex reduced sooty blotch significantly in 2004. The tank mixture of Myco-Sin and Cocana RF gave some control of sooty blotch but led also to unacceptable visible residues on the apples. Myco-Sin alone was as efficient as Cocana RF. Neither product left any visible residues on the fruit. In 2005, lenticell spotting (probably caused by Pseudomonas syringae) was observed in Cocana RF and even more pronounced in Armicarb plots, but not in Myco-Sin treated plots (data not shown).

Discussion

Armicarb (Potassium bicarbonate) provided excellent control against apple scab as well as sooty blotch in field trials conducted in 2004 and 2005. The efficacy of Armicarb was as good as the reference treatments (i.e. sulphur against scab, Cocana RF against sooty blotch). The data suggest that best results against scab can be obtained if Armicarb is combined with wettable sulphur. So far, no data are available on efficacy of Armicarb in low temperature conditions. However, activity below 10 °C is a prerequisite if copper is to be replaced.

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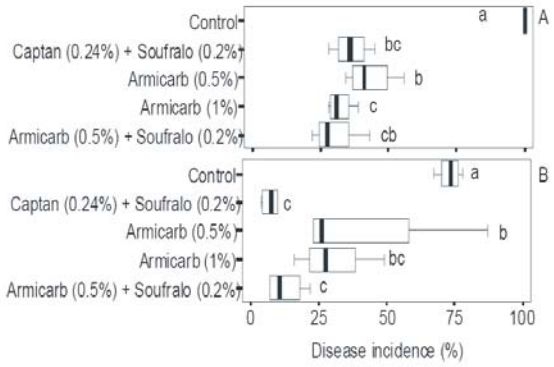

Figure 1. Impact of Armicarb on disease incidence caused by Venturia inaequalis *on leaves (A) and apple fruit (B) on 24.6.2005 in Prangins (cv Golden Delicious). Treatments with different letters differ significantly (p<0.05).*

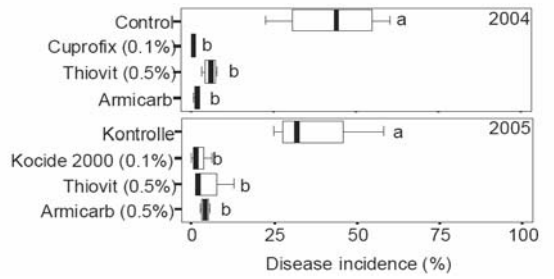

Figure 2. Impact of Armicarb on disease incidence caused by Venturia inaequalis *on leaves in trial 1 on 17.6.2004 and trial 2 on 24.6.2005 in Frick (cv Rubinette). Treatments with different letters differ significantly (p<0.05).*

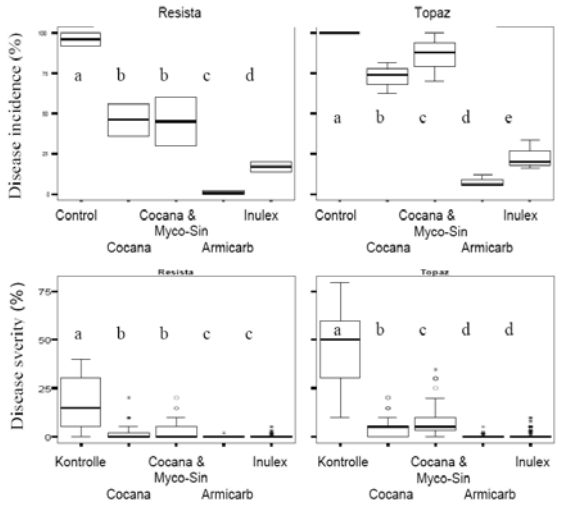

Figure 3. Impact of treatments on Sooty blotch in Pfyn on 16.09.2004. Treatments with different letters differ significantly (p<0.05).

Armicarb shows excellent activity against sooty blotch. However, we observed in 2005 that application of Armicarb may result in an increase of lenticell spots in cv. Topaz. The causal agent for lenticell spots has not been identified. Since spots occurred in all treatments, except Myco-Sin, we speculate that Armicarb may be conducive to the causal agent (e.g. Pseudomonas syringae) but is not the causal factor itself. However, further studies will show the-potential and limits of Armicarb in organic apple orchards.

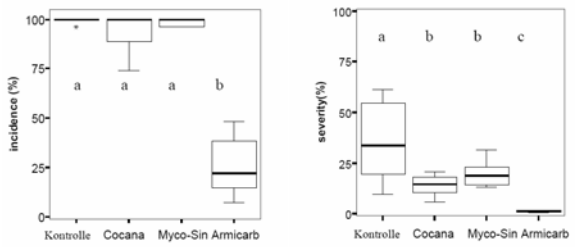

Figure 4. Impact of Cocana RF (1%), Myco-Sin (0.8%) und Armicarb (0.5%) treatments on sooty blotch development on cv Topaz on 9. September 2005. Treatments with different letters differ significantly (p<0.05).

In Switzerland, further trials with Armicarb will be conducted in 2006 in order to identify more precisely the potential and limits of the product as well as to develop application strategies that fit into current organic apple growing systems. At present, potassium bicarbonate is considered by the Swiss registration authorities as non-toxic to humans and in consequence, no residue levels have been specified. Therefore, it may be speculated that Armicarb can be applied on fruit until harvest without risk of unacceptable residues.

In conclusion, Armicarb has very interesting properties as a plant protection agent and its composition and risk profile are expected to fulfil the IFOAM standards for acceptance of novel plant protection agents to a very large extent.

Acknowledgement

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References

Anonymous (2005a). Armicarb Factsheets. www.greenbook.net

Anonymous (2005b) Potassium bicarbonate (073508) and Sodium bicarbonate (073505) Fact Sheet www.epa.gov/pesticides/biopesticides

Fuchs, J.G., Häseli, A. and Tamm, L. (2002). In "Proceedings 10th International Conference on cultivation technique and phytopathological problems in organic fruit-growing and viticulture." pp. 50-54, ed FÖKO.

Köhl, J. et al. (2004). REPCO: Replacement of Copper Fungicides in Organic Production of Grapevine and Apple in Europe. http://www.rep-co.nl/

Tamm, L., Amsler, T., Schärer, H. and Refardt, M. (2006). In "Proceedings 12th International Conference on Cultivation Technique and Phytopathological Problems in Organic Fruit Growing", pp. 87-92, edn Fördergemeinschaft Ökologischer Obstbau e. V.: Weinsberg, Germany.