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Control Seed-borne Fungi by Radio Frequency Heat Treatment as Alternative Seed Treatment in Barley (*Hordeum vulgare*)

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Introduction

Fungi contamination probably affects the quality in both direct and indirect manners. Direct effects upon grain quality may be due to the growth and ramification of the fungus throughout the kernel and the production of metabolites which may alter grain composition or metabolism, or render it unfit for human or animal consumption. Indirect effects relate to reductions in yield that are associated with contamination (SCHWARZ, 2001). Barley seed is potentially to the ravaged by seed borne disease. Seed-borne fungi in barley have the potential effect on malting and malt quality, brewing performance and beer composition (Cook, 1962; SCHWARZ, 2001; MEDIN, 2006). Radio frequency heat treatment is an alternative way with high potential to control seed-borne fungi. The thermal energy of radio frequency is transported into the material by an alternating electromagnetic field and heat can only be generated where dielectric loss occurs. This leads to the so-called "*internal heating*" (Nelson and ELDA, 1961) become new alternative technology which help about eliminate seed-borne fungi and maintain seed quality (NELSON, 1985; CWIKLINSKI AND VON HÖRSTEN, 1999). CWIKLINSKI (2001) reported the effect of RF treatment on germination and infection rate of wheat seed and the results showed that radio frequency treatment led to a complete eradication of *Fusarium graminearum* in wheat seed while maintaining germination. Therefore, the aim of this study are 1) investigating the efficiency of radio frequency on control seed-borne fungi in barley seed and 2) studying its effect on germination, and alternative leading to new methods in solving problems concerning seed-borne fungi**.**

Material and Method

The barley seed "Baudin" variety with the initial moisture content 14.5% were treated with radio frequency heat treatment application unit, which has been developed and built at the Institute of Agricultural Engineering, University of Göttingen, Germany at 27.12 MHz. The input power was 24 %. The first experiment was to determine effect of the various treated temperatures as followed: 60, 65, 70, 75 and 80 ºC for one-fixed 3 minutes time used. The second experiment 1, 3, 5 and 10 minutes were selected as time used. After that seed health test was assayed by blotter method. Standard germination test was assayed by ISTA RULE 2006. The analysis of variance was carried out using Factorial in Randomized Complete Block Design (RCB) for 4 replications. The difference between treatments means were evaluate by least significance difference (LSD) test. The experiment was done at Seed laboratory, Faculty of Agriculture and Postharvest laboratory, Chinng Mai University, Thailand.

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Results and Discussion

Exposure of barley seed to radio frequency heat treatment result in the reduction of seed-borne pathogen. When naturally infected seed were treated with radio frequency, the percentage of fungus was suppressed as showed by the increased in the percentage of fungi infection. The results showed that barley seed were infection of seed-borne fungi such as *Aspergillus flavus, Alternaria* sp., *Penicillium* sp. and *Rhizopus* sp. (**Fig. 1**)

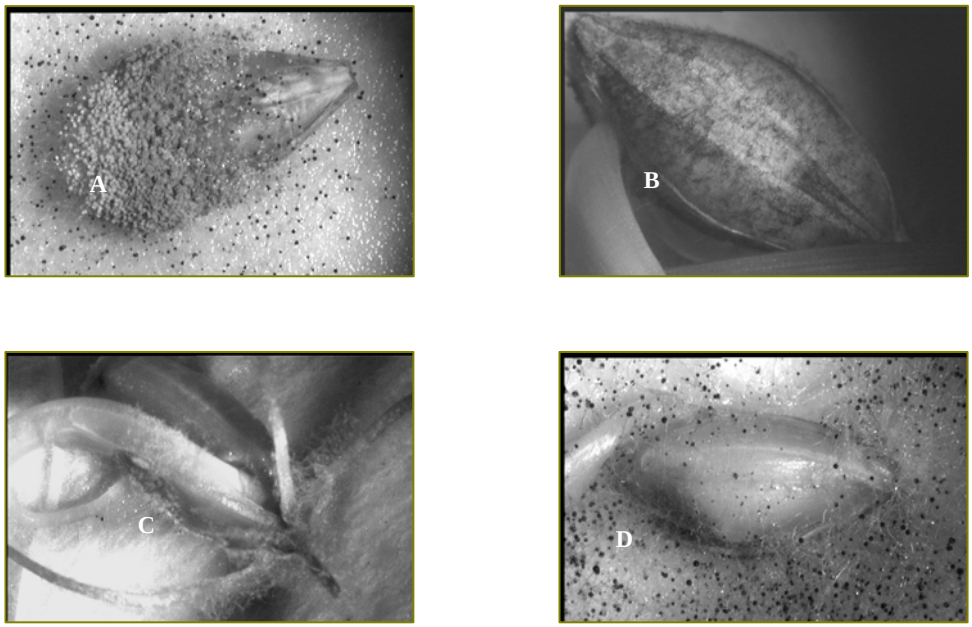
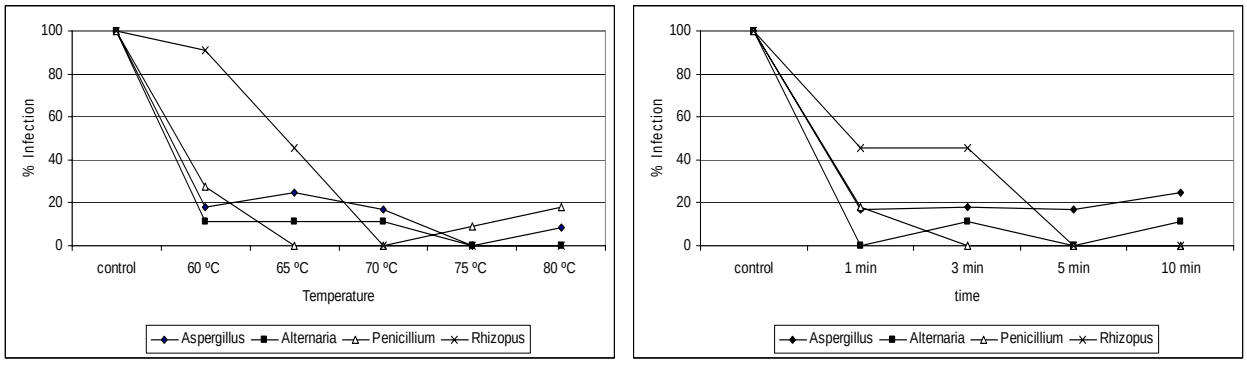


Fig. 1: The contamination of seed-borne fungi in barley seed *Aspergillus flavus* (A), *Alternaria* sp. (B), *Penicillium* sp. (C) and *Rhizopus* sp. (D)

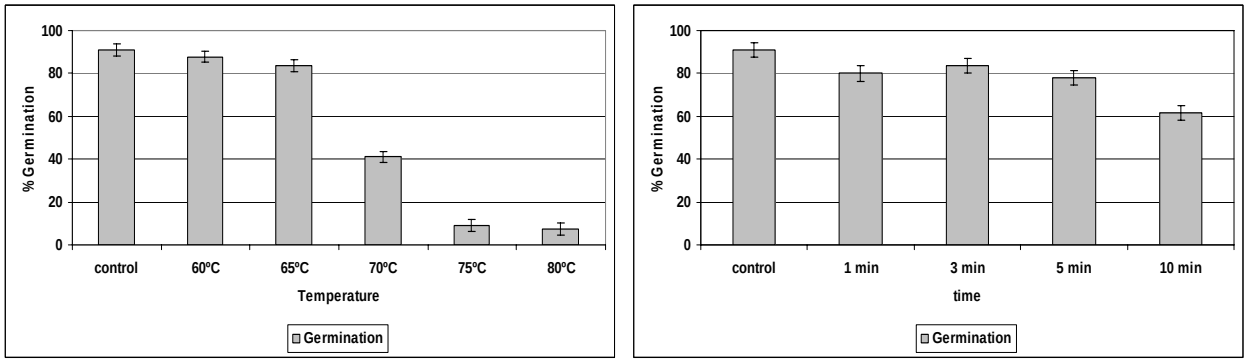
After treating barley seed with RF, the result showed that temperature higher than 65°C can decrease the percentage of seed-borne fungi infection, but at 75°C (**Fig. 2A**) completely eliminate *Aspergillus flavus* , *Alternaria* sp. and *Rhizopus* sp. except *Penicillium* sp. which was 9.1% of infection. Then in the second experiment 65°C was selected as target temperature. Used 5 and 10 min were the efficient time to control seed-borne fungi (**Fig. 2B**)



(A) (B)

Fig. 2: The infection percentage of seed-borne fungi in barley seed after treated with radio frequency at 3 minutes (A) and 65 ºC (B).

Germination of seed treated at 65ºC for 3 min were decrease from 91% to 83%. In contrast, germination percentage of seed treated at 75ºC was decrease to 9% (**Fig. 3A**). Moreover, treated RF at 65ºC for 5 min time used decreased the germination percentage to 78% in second experiment (**Fig. 3B)**.



(A) (B)

Fig. 3: The germination percentage of barley seed after treated with radio frequency heat treatment at 3 minutes (A) and 65ºC (B).

It was found that the decreasing of the percentage of seed-borne fungi was related to the temperature and time to used RF heat treatment according to NELSON AND WALKER (1961), the moisture content was a very important factor in determining the maximum temperature of RF application. At high initial moisture content a larger proportion of energy was absorbed by free inside the material. VASANACHALORN *et al.*, (2004) treated sesame seed with RF, the best level was at 70ºC with seed moisture content of 10%, all fungi invasion was decreased to 51% whereas the percentage of seed germination was 73%. JANHANG *et al.,* (2005) reported that using RF heat treatment at 75ºC for 180 sec can decreased infection of *Trichoconis padwickii* to 18% while maintain rice seed viability. VASANACHALORN *et al.,* (2006) was found that at temperature 85ºC with 14% initial moisture content, the percentage of *Fusarium semitectum* infection was only 2%.

Conclusions

The best temperature used was at 65ºC for 5 min. Seed-borne fungi, *Aspergillus flavus, Alternaria* sp., *Penicillium* sp. and *Rhizopus* sp. were decreased to 16.7, 0, 0 and 0%. Moreover, used RF heat treatment can remain germination percentage from 91% to 78%. Therefore, using of RF application can be a new alternative to control seed-borne fungi, have a sort processing and maintain seed quality in barley seed.

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