J. of Plant Production, Mansoura Univ.,Vol 10 (9):757-762, 2019

Journal of Plant Production

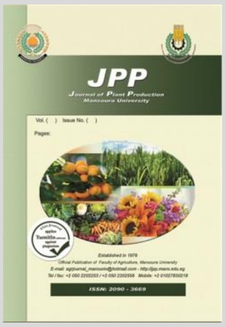
Journal homepage: www.jpp.mans.edu.eg
Available online at: www. jpp.journals.ekb.eg

Effectiveness of Fungal Disinfectants under Various Seed Drying Treatments on Physiological Seed, Quality and Field Performance of Wheat Seedlings

Zalama, M. T. and N. E. Attia*

Seed Technology Research Department, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt.

Cross Mark



ABSTRACT

Laboratory and field experiments were conducted to estimate the effect of fungal disinfectant (Tendro 40% FS) and seed drying treatments and their interaction on physiological quality and field performance of wheat seed. Seeds were exhibited to the fungal disinfectant concentrations *i.e*., $5cm^3kg^{-1}$, $3cm^3kg^{-1}$ and $7cm^3kg^{-1}$ seed in addition to undressed seed as control treatment, while the second factor was seed drying treatments *i.e*., natural drying (indirect sunlight), interrupted drying (hot air dryer) and rapid drying (oven dryer). Factorial experiment in RCD and RCBD with 4 replicates were set to perform laboratory and field experiments, respectively. All fungal disinfectant concentrations significantly enhanced the germination indices over the untreated seed, while $5cm^3kg^{-1}$ treatment showed the greatest increase upon control of G% (5.4%), FE% (7.4%), SDW (40%) and (23%), SVI (46.2%) and (27.2%) of laboratory and field performance, respectively. SMC ranged from 11.18%, 11.07% and 11.0% for natural, interrupted and rapid drying treatments, respectively. More, rapid drying recorded the highest loss of water in the shortest period of drying which was 4h(4h×1day), followed by interrupted and natural drying treatments which recorded 8h(4h×2days) and 24h(6h×4days), respectively. Moreover, the interrupted drying significantly permits the higher values of G% (93.5%), FE% (87.8%), SDW (0.20_g) and (0.17_g) and SVI (0.19) and (0.15) of laboratory and field performance, respectively. Finally, the interaction treatments showed no significant effect but on MGT_{day} trait, more treatment $5cm^3kg^{-1}$×8h of interrupted drying showed the highest seed physiological and field performance values upon the other interaction treatments.

Keywords: Wheat, fungal disinfectants, seed drying, seed moisture, seed quality, field performance.

INTRODUCTION

Since seeds with high moisture contents have a high respiration rate and are liable to be attacked by micro-organisms, insects and other pests, which from the greatest reason to decrease germination and vigor (Sawant *et al.*, 2012). In wheat grains, the moisture should be ranged from 18 to 20 % at harvesting time, then after that seeds should have to be dried in order to decrease moisture contents to 12 % for safe storage or 13.5 % for immediate sale. If the moisture in the seeds is more than 12 % at the time of storage, the high levels of both heat and water, increased intensify of respiration in seeds, increases the risk of fungal disease, pest and other disease attack and lead to reduce the quality of seeds (Mantovani, 2003). Likewise, seeds should be stored in proper moisture.

Fungal diseases which requires higher moisture above 18 %, taken place commonly in all the cultivated grains and have been found to cause most damage such as abortion, rot, necrosis, discoloration, reduced germination and vigor, and may harm or kill the seedlings before or after emergence (Hagedorn, 1984 and Shetty, 1988). Due to infection in seeds, wheat crop gets different diseases which adversely affect the annual production. The infection from such diseases could be minimized or reduced by using only healthy and good quality seeds chosen through treatment with fungicide, which actually enhancing the ability to protect seeds from attacking by the infection and to prevent the destruction of seed germination and seedling growth during the period of high sensitivity (Khatiwada, 2016). Many seed disinfectants depending on its chemically compositions and its concentrations will probably control certain diseases, but at the same time, might depressed, maintained or little increased the vigor of seed and seedling growth.

Losses in wheat products or grains is the main problem emerge through poor drying practice. Therefore, good and healthy drying practice is critical for minimizing post-harvest losses, since it directly affects safe storage of seeds. Seed drying treatments, natural or artificial might be based on features of each of species such as, the sample size of harvested seeds and on climate conditions after seeds were harvested. The natural drying which conducted directly under the sunlight or indirectly under the shade is widely important in seed production process, as it fetch homogeneous and consistent post-harvest seed maturation (Berti *et al*., 2005). Artificial drying methods are more oftentimes applied, which are more easily adjustable in seed production techniques, affording rapid and efficient removal of large amounts of moisture in shorter times (Carvalho, 1994). These methods achieve the maintenance of seed quality when proceed under technical criteria and

* **Corresponding author.**
E-mail address: Nasserfouda67@gmail.com
DOI: 10.21608/jpp.2019.56981

several aspects should be considered when choosing between seed drying methods to be used with minimal damage for physical and physiological seed quality, such as specific characteristics of each product harvested, effectively amounts of harvested seed, harvest speed rate, duration time of drying, energy consumption, seed end purpose and human knowledge of technology and production (Maia, 1995).

The purpose of the present research paper was to study the effect of three concentrations of fungal disinfectant (Tendro 40 % FS), three types of seed drying treatments and their interactions on the possibility of improving or maintaining seed germination indices, seedling vigor and field performance of wheat seedlings.

MATERIALS AND METHODS

This study was conducted through two experiments, one at the laboratory of Seed Technology Research Unit, Mansoura City, Field Crops Research Institute, Agricultural Research Center, Giza, Egypt. The second experiment, was conducted at experimental farm in Faculty of Agriculture, Mansoura University, Egypt. Seed samples of wheat cultivar (Misr 1) were received from Seed Central Administration for Seed Testing and Certification (CASTC), Egypt, from the harvested season May 2017, with an initial seed moisture content of 16 ± 0.2 %. Halve kg of seed samples were taken for each treatment, then packed in muslin cloth bags for applying seed treatments.

Both of laboratory and field experiments consisted of two factors; the first factor consisted of four treatments which were, seed dressing of three different concentrations of commercial fungal disinfectant (Tendro 40 % FS) *i.e.*, $5cm^3kg^{-1}$ (standard conc.), $3cm^3kg^{-1}$ and $7cm^3kg^{-1}$ seed, in addition to undressed seed (control treatment). The second factor included three seed drying treatments i.e., natural drying (ND), interrupted drying (ID) and rapid drying (RD) treatments.

Fungal disinfectant treatments take the form of quick-wet method (seed dressing). Firstly, seed samples were packed in muslin cloth bags, then fully immersed in each concentration of fungal disinfectant solution and shaken for 2 minutes until have been dressed with the solution, thereafter the seeds were allowed to dry for 24 hours under surrounding laboratory conditions.

Natural drying (ND) treatment induced by the indirect daily sunlight conditions (24±2°C and 30±3%RH), seed moisture content was measured three times a day using a digital Multi grain moisture meter until reaching the constant moisture content of 11.18% (until no change in moisture content) and the exposure time took 24 hours (6h×4days) of drying period. Interrupted drying (ID) treatment induced by the hot air dryer (model Retsch TG100, 230V&50Hz), the seed samples were transmitted to the dryer modified to a 1m/s of flow rate, 40°C of air temperature and 20% air humidity, seed moisture content was estimated every hour by Multi Grain meter till seeds reached the constant moisture content of 11.07 % and the exposure time took 8 hours (4h / 2days) of drying period. Rapid drying (RD) treatment induced by oven dryer under forced-air ventilation, temperature was optimized at 40°C, seed moisture content was estimated every hour and the constant moisture content reached 11.0% and the exposure time took 4 hours (4h /1day) of drying period.

Dried treatment samples were packed in sealed Polyethylene bags for further seed physiological quality and field performance assessments.

Laboratory experiment

Germination procedure

In order to assess the germination and physiological quality of the seeds, four replicates of 200 seeds per each treatment were sown on the top of whatman No. 1 filter paper moistened with 10 ml of distilled water in sterilized Petri-dishes (14cm diameter), each Petri-dish contain 25 seed, four Petri-dishes kept close together and counted as though they were one replication and preserved in growth chamber at 25°C. Germination progress was measured at 24 h intervals and continued until the fixed state of 7 days after planting treatments.

Randomized Complete Design (RCD) with four replicates was set to perform the experiment with two factorial concepts, 4 fungal disinfectants × 3 seed drying treatments.

Physiological seed quality assessments

Germination indices were measured according to ISTA (2011) as follow; Germination percentage

$$(G\ \%) = \frac{\text{Total number of germinated seeds}}{\text{Total number of seeds evaluated}} \times 100.$$

Energy of germination (EG %) was determined on the 4th day of seed sowing as recorded by Ruan *et al.* (2002) as follow;

$$EG\ \% = \frac{\text{Germination percentage after four days}}{\text{Total number of seeds tested}} \times 100.$$

Mean Germination Time (MGT_{day}) calculated according to Ellis and Roberts (1981) formula;

$$MGT = \frac{\sum(D \times n)}{\sum n}$$

where

n, is the number of seeds germinated on day D and D is the number of days counted from the beginning of the test.

Accelerated aging test (AAT) was taken place as follow; 100 seeds for each treatment were placed in accelerated aging specific containers and kept at 41°C for 72h and 100 % RH (ISTA, 2006).

Seedling length (cm), ten seedlings were taken randomly per each replicate to measure seedling length expressed in cm at the end of standard germination test.

Seedling dry weight (g), ten seedlings were oven-dried at 70ºC until constant drying weight was reached, according to Agrawal (1986).

Seedling vigor index (SVI-II) measured by the formula;

$$SVI\text{-}II = \frac{\text{Seedling dry weight} \times \text{Germination percentage}}{100}$$

According to Abdul- baki and Anderson (1973).

Field performance experiment

The field experiment was conducted at experimented farm in Faculty of Agriculture, Mansoura Univ., Egypt, in the 15th of November, 2017. About 300 wheat seeds per square meter were sown, the sowing rate was 2-3 seeds per seedbed with 10 cm distance between holes, 25 cm between lines and 1-1.5 cm of depth sowing. After sowing, the soil slightly pressed in order to compact the soil, to maintain the soil moisture and permit the seeds to obtain more water. The experiment was set according to factorial experiment in Randomized Complete Block Design (RCBD), with four replicates and the experiment consisted of 48 treatment combinations of 4 fungal disinfectants × 3 seed drying treatments× 4 replicates.

Field performance assessments

Field emergence (FE%) was recorded from sowing date and continued until no further emergence taken place at 7^{th} day. At the seedling stage, 10 plants from each treatment were picked to estimate mean emergence time (MET_{day}), seedling length (cm), seedling dry weight (g) and seedling vigor index (SVI-II), as shown before.

The obtained data were statistically analyzed according to the technique of analysis of variance (ANOVA) for the Randomized Complete Design (RCD) for laboratory experiment and the Randomized Complete Block Design (RCBD) for field experiment as published by Gomez and Gomez (1984) using "MSTAT-C" computer software package. Least significant difference (LSD) method was used to test the differences among means of treatment at 5 % level of probability as described by Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Results

Respective drying curve induced by seed moisture content (SMC %)

Moisture content curves of wheat seed over drying times (hours) exposed to three different drying treatments were presented in Figure 1. The respective drying curves clarified that the removal of moisture from seeds was growing slower with time in natural drying (ND) induced by the indirect sunlight conditions which taken 4h×6days of drying period, followed by the artificial drying treatment as interrupted drying (ID) induced by the hot air dryer which taken 4h×2days while it was substantially faster in rapid drying (RD) induced by oven dryer conditions which taken 4h×1day of drying period. Furthermore, the RD seed treatment showed the highest loss of seed moisture in the shortest period of time followed by ID and ND treatments, which were 4h, 8h and 24h, respectively as shown in Figure1.

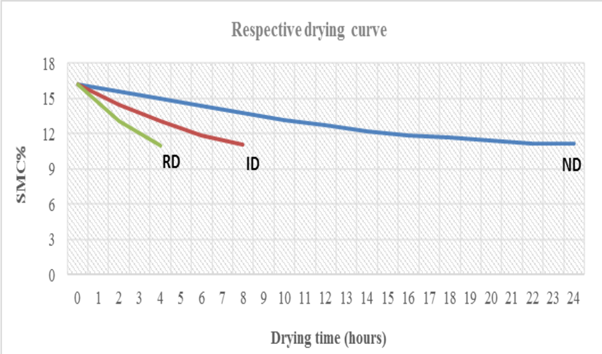


Figure 1. Drying curves representing seed moisture contents (SMC%) of wheat seeds in terms of drying time, natural drying (ND), interrupted drying (ID) and rapid drying (RD) methods.

Physiological seed quality assessments

The analysis of variance for the physiological seeds quality assessments showed statistically significant differences (P<0.05) between fungal disinfectant (Tendro 40% FS) concentrations and seed drying treatments. All disinfectant concentrations revealed high indices of germination and seedling vigor measurements as compared to the undressed seed (cont.). Treatment of $5cm^3.kg^{-1}$ recorded the highest values of G (93.6%), seedling length (22_{cm}), SDW (0.21_g) and SVI-II (0.19) and hardly decrease the MGT (3.41_{day}), whereas treatment of $7cm^3.kg^{-1}$ recorded the highest values of EG (81.7%) and they share the same value of AAT (88.8%). Furthermore, the values of $3cm^3.kg^{-1}$ treatment slightly comes down compared to the other treatments, as pointed in Table 1.

Table 1. Physiological seed quality assessments as affected by three concentrations of fungal disinfectant and three seed drying treatments of wheat seeds.

Traits/Treatments	G (%)	AAT (%)	EG (%)	MGT(day)	Seedling length(cm)	SDW (g)	SVI-II
Disinfectant (Tendro 40% FS)							
- Undressed seed (Cont.)	88.8	83.4	76.7	3.80	19.8	0.15	0.13
- 5 $cm^3.kg^{-1}$ (Standard conc.)	93.6	88.8	81.5	3.41	22.0	0.21	0.19
- 3 $cm^3.kg^{-1}$	91.1	85.3	80.2	3.63	20.9	0.16	0.14
- 7 $cm^3.kg^{-1}$	92.9	88.8	81.7	3.45	21.2	0.17	0.16
LSD 0.05	2.5	2.6	4.4	0.1	0.3	0.02	0.02
Drying methods							
- Natural drying (ND)	91.2	85.7	79.1	3.59	20.9	0.17	0.16
- Interrupted drying (ID)	93.5	89.5	83.4	3.43	21.6	0.20	0.19
- Rapid drying (RD)	90.1	84.5	77.6	3.70	20.4	0.14	0.13
LSD 0.05	2.2	2.3	3.8	0.08	0.3	0.02	0.02

G%: Germination percentage, AAT: Accelerated aging test, EG%: Energy of germination, MGT_{day}: Mean germination time, SDW_g: Seedling dry weight and SVI-II: Seedling vigor index

The interrupted drying (4h×2days) treatment of seeds resulted in higher germination and seedling vigor indices i.e., G (93.5%), AAT (89.5%), EG (83.4%), seedling length (21.6_{cm}), SDW (0.20_g) and SV-II (0.19) and the lowest MGT (3.43_{day}), as compared to natural and rapid drying treatments. Moreover, natural drying treatment slightly increase the mean values of seed vigor and slightly decrease MGT_{day} parameters as compared to rapid drying treatment, as shown in Table 1.

Results presented in Table 2 showed the interaction effects at $LSD_{0.05\%}$ between fungal disinfectant and seed drying treatments and pointed that, the interaction treatments (Tendro 40% FS × seed drying) recorded the highest mean values of all measurements compared with the undressed seeds (cont.), while the treatment of $5cm^3.kg^{-1}$ surpass the other concentration treatments with regard to the interaction mean values of G%, SDW_g and SVI-II, meanwhile there were a slight differences between $5cm^3.kg^{-1}$ and $7cm^3.kg^{-1}$ treatments with regard to AAT%, EG% and MGT_{day} measurements. Moreover, the interrupted drying (4h×2days) of seeds showed the greatest interaction effects of all measured characters against natural and rapid drying treatments with the exception of energy of germination. Meanwhile, the natural drying slightly increases those parameters over rapid drying treatment. The treatment of $5cm^3kg^{-1}$×ID gave a higher value of G% (96.5%), AAT (92.2%), and SVI-II (0.24) and the lowest value of MGT (3.32_{day}). While the treatments of $7cm^3.kg^{-1}$×ID and $5cm^3.kg^{-1}$×RD recorded the highest values of EG (85%) and SDW (0.27_g) respectively, as shown in Table 2.

Table 2. Physiological seed quality assessments as affected by the interaction between three concentrations of fungal disinfectant and seed drying treatments of wheat seeds.

Fungal disinfectants × Seed drying	G% Mean±2SD	AAT% Mean±2SD	EG% Mean±2SD	MGT_{day} Mean±2SD	SDWg Mean±2SD	SVI-II Mean±2SD
Undressed seed × ND	88.6±3.7	82.9±2.3	74.0±3.3	3.78±0.30	0.15±0.02	0.13±0.02
Undressed seed × ID	90.8±1.0	87.7±2.3	82.5±10	3.54±0.10	0.18±0.00	0.16±0.00
Undressed seed × RD	87.1±4.0	79.6±3.2	73.7±5.5	4.10±0.30	0.11±0.03	0.10±0.02
5 $cm^3.kg^{-1}$ (s conc.) × ND	93.3±2.1	87.9±9.6	81.0±7.8	3.45±0.10	0.20±0.05	0.18±0.04
5 $cm^3.kg^{-1}$ (s conc.) × ID	96.5±0.8	92.2±5.9	84±23.5	3.32±0.03	0.25±0.05	0.24±0.05
5 $cm^3.kg^{-1}$ (s conc.) × RD	91.0±3.2	86.4±2.4	79.7±3.7	3.46±0.20	0.27±0.06	0.16±0.06
3 $cm^3.kg^{-1}$ × ND	90.6±2.5	83.2±2.5	79.7±6.2	3.67±0.30	0.16±0.06	0.14±0.05
3 $cm^3.kg^{-1}$ × ID	92.2±14	89.0±12	82.2±5.7	3.47±0.30	0.19±0.07	0.17±0.07
3 $cm^3.kg^{-1}$ × RD	90.8±6.0	83.7±1.9	78.7±4.4	3.74±0.20	0.13±0.01	0.12±0.01
7 $cm^3.kg^{-1}$ × ND	92.4±7.0	88.9±7.1	82.0±13.8	3.47±0.20	0.18±0.04	0.16±0.04
7 $cm^3.kg^{-1}$ × ID	94.7±3.8	89.2±9.0	85.0±13.6	3.40±0.20	0.19±0.09	0.18±0.08
7 $cm^3.kg^{-1}$ × RD	91.7±9.4	88.5±6.8	78.2±11.1	3.49±0.20	0.15±0.04	0.14±0.04
Means	91.64	86.60	80.06	3.57	0.18	0.16
LSD 0.05	4.3	4.5	7.6	0.2	0.04	0.03

G%: Germination percentage, AAT: Accelerated aging test, EG%: Energy of germination, MGT_{day}: Mean germination time, SDW_g: Seedling dry weight and SVI-II: Seedling vigor index

Field performance assessments:

Table 3 showed that, all fungal disinfectant concentrations treatments significantly ($P<0.05$) surpassed the undressed seed treatment (cont.) for all field assessments with one exception. The concentration of $5cm^3.kg^{-1}$ treatment obtained the higher aspects of FE (87.6%), SDW (0.16_g) and SVI-II (0.14) and the lower MET (3.59_{day}), while the higher value of seedling length (19.5_{cm}) was obtained by $7cm^3.kg^{-1}$ treatment. Moreover, $3cm^3kg^{-1}$ and $7cm^3.kg^{-1}$ treatments recorded the same values for SDW (0.15_g) and SVI-II (0.13).

Table 3. Field performance assessments as affected by three concentrations of fungal disinfectant and three seed drying treatments of wheat seeds.

Traits / Treatments	FE (%)	MET (day)	Seedling length (cm)	SDW (g)	SVI-II
Disinfectant (Tendro 40% FS)					
- Undressed seed (Cont.)	81.5	3.92	16.2	0.13	0.11
- 5 $cm^3.kg^{-1}$ (Standard conc.)	87.6	3.59	19	0.16	0.14
- 3 $cm^3.kg^{-1}$	85.4	3.73	17.1	0.15	0.13
- 7 $cm^3.kg^{-1}$	85.9	3.66	19.5	0.15	0.13
LSD 0.05	3.2	0.11	0.67	0.01	0.01
Drying methods					
- Natural drying (ND)	84.9	3.69	18.1	0.15	0.12
- Interrupted drying (ID)	87.8	3.62	18.7	0.17	0.15
- Rapid drying (RD)	82.6	3.86	17.0	0.13	0.11
LSD 0.05	2.7	0.1	0.58	0.01	0.01

FE%: Field emergence percentage, MET_{day}: Mean emergence time, SDW_g: Seedling dry weight and SVI-II: Seedling vigor index.

The interrupted drying (4h×2days) treatment induced by hot air dryer gave values of field emergence FE of 87.8%, seedling length (18.7_{cm}), SDW(0.17_g) and SVI-II (0.15), which were higher than those observed when compared to the other two drying treatments (*i.e.*) natural or rapid drying. The benefits from seed treatment of natural drying coming through sunlight were significantly greater than the rapid drying obtained by the oven dryer, with respect to most of the field performance measurements (Table 3).

Table 4 showed the means of the interaction effects between fungal disinfectant concentrations and seed drying treatments at $LSD_{0.05\%}$. Data statistically pointed that, the treatment with Tendro 40% FS of $5cm^3.kg^{-1}$ treatment was the superior over the other disinfectant concentration treatments and the untreated seed, which recorded higher interaction values of FE%, SDW_g and SVI-II and lower values of MET_{day}.

Table 4. Field performance assessments as affected by the interaction between three concentrations of fungal disinfectant and seed drying treatments of wheat seeds.

Fungal disinfectants × Seed drying	FE% Mean±2SD	MET_{day} Mean±2SD	SDWg Mean±2SD	SVI-II Mean±2SD
Undressed seed × ND	80.4±3.6	3.85±0.15	0.13±0.02	0.11±0.02
Undressed seed × ID	84.8±6.2	3.69±0.26	0.15±0.02	0.12±0.02
Undressed seed × RD	79.3±4.8	4.23±0.44	0.11±0.04	0.09±0.02
5 $cm^3.kg^{-1}$ (s conc.) × ND	87.9±3.5	3.56±0.11	0.15±0.03	0.13±0.03
5 $cm^3.kg^{-1}$ (s conc.) × ID	90.5±4.1	3.54±0.19	0.18±0.03	0.17±0.04
5 $cm^3.kg^{-1}$ (s conc.) × RD	84.5±5.4	3.66±0.31	0.13±0.04	0.11±0.03
3 $cm^3.kg^{-1}$ × ND	84.8±2.6	3.72±0.16	0.14±0.02	0.12±0.01
3 $cm^3.kg^{-1}$ × ID	89.2±1.9	3.61±0.16	0.17±0.02	0.15±0.02
3 $cm^3.kg^{-1}$ × RD	82±4.9	3.86±0.24	0.13±0.01	0.11±0.01
7 $cm^3.kg^{-1}$ × ND	86.3±4.2	3.64±0.31	0.15±0.02	0.13±0.02
7 $cm^3.kg^{-1}$ × ID	87±22.9	3.65±0.34	0.17±0.03	0.15±0.06
7 $cm^3.kg^{-1}$ × RD	84.4±5.2	3.69±0.29	0.14±0.02	0.12±0.02
Means	85.09	3.73	0.15	0.13
LSD 0.05	5.47	0.19	0.02	0.02

FE%: Field emergence percentage, MET_{day}: Mean emergence time, SDW_g: Seedling dry weight and SVI-II: Seedling vigor index.

The interrupted drying induced by the hot air dryer showed the major interaction effects on most of the field performance measurements, followed by natural and rapid drying treatments, respectively. Regarding to the interaction means, $5cm^3kg^{-1}$×ID treatment exceeded the other interaction mean values of FE% (90.5%), SDW (0.18_g) and SVI-II (0.17) and the lower expression of MGT (3.54_{day}).

Discussion

Effect of fungal disinfectant treatments

The seedlings that emerged from seeds which treated with fungal disinfectant treatments were success to control the potential seed-born and soil borne diseases and significantly improved seedling growth and vigor measurements, in contrast to untreated seeds which failed to control the potential soil diseases and recorded the lowest values (Hagedorn, 1984), also caused reduction of yield and seed quality induced by the presence of discoloured seeds, which in turn can be contaminated by mycotoxins

(O'Donnell *et al*., 2000). Previous researches discussed that, applied general fungicides treatments to seeds may provide protection during germination, emergence and the early establishment stage of the plant (Jensen *et al*., 1998), increased germination, seed viability, vigor and yield (Aamil *et al*., 2004), significantly lowered pre and post emergence damping off (Lamprecht *et al*., 1990), improved length and dry weight of shoots and roots (Munkvold and O'Mara, 2002), early plant growth, rapid, healthy stand establishment and flowering and acquire high yield (Doyle *et al*., 2001) and reduced storage fungi which can obstruct the plant growth and reduce their performance (Smith *et al*., 1999). Thus, previous researches and our present results proved in general that, disinfectant fungal with any chemical application with recommended dosage should help seeds to maintain its viability, vigor and emergence percentage and do not produce any detrimental effect on seed performance and seedling development (Zhang and Hampton, 1999).

Efficiency of seed drying curves

The efficiency of drying curves might be more widely related to the method itself and to the effect of weather conditions, which may have influenced the fact that bound water remains for longer times inside the seed, which in turn produces gases, vapor in the intergranular space and takes up reserves of energy and rather affects seed germination and vigor (Maia, 1995; Franke *et al*., 2008). In addition, the direct effects caused by drying process included assimilation of cotyledon reserves on the embryonic axis, their implications for storage and increasing accuracy of physiological potential of seeds at different periods (Hartmann Filho *et al*., 2016).

Effect of seed drying treatments

The physiological seed quality significantly affected by the different drying temperature, in which a decrease in germination indices were observed especially at temperature over 40°C (Ullmann *et al*., 2015). As long as the drying process were completely performed well, it significantly affects germination, seedling vigor and accumulate more dry matter (Pereira *et al*., 2015). Slow drying induced by natural drying (ND) under the indirect sunlight conditions may have the impact to preserve the seed at highly moisture content and relatively temperature, which accelerate the deterioration and so prevent intended drying and finally led to decrease the potential seed and seedling vigor (Kelly, 1988). Increasing the temperature of drying as produced by oven dryer (RD) under forced-air ventilation actually increase the rate of water removal from seeds, which led to produce a stark difference between the external and the internal part of seed, promotes the formation of seed coat cracks and micro-fissures in the cotyledons, affecting the seed physiological quality. More affects such as these, increase the susceptibility of the material to latent damage, or even worsen deterioration, thus reducing the seed storage potential and its physiological quality (Mbofung *et al*., 2013), these results actually were proved by the rapid drying (RD) method induced by oven temperature, which associated with the caramelization of the Maillard reaction and hardly causes enzymatic denaturation and degradation, pigment loss and decline in phytochemicals, which potentially leads to decrease seed viability and seedling vigor (Sun and Leopold, 1995; Arslan and Özcan, 2010).Wheat seed have a higher resistance to airflow drying air temperatures but should be below 43°C or lower to avoid seed damage, these results demonstrated by interrupted drying (ID) method by controlling the heat through breaking up the hot spots in the dryer which usually cause problems to seed, this method (ID) award the maintenance of seed quality, when proceed under optimized technical criteria such as exposure times and temperatures (Ahrens *et al*., 2000) which coincide with our findings herein.

CONCLUSION

Treated wheat seeds by fungal disinfectant Tendro 40% FS with concentration of 5cm3kg-1 as well as seed drying treatments through interrupted drying depended on the hot air dryer for 8 hours, substantially improving or maintain physiological seed quality and field performance assessments of wheat seeds.

ACKNOWLEDGMENTS

The authors are grateful to the management of Seed Technology Researches Unite, Mansoura City for assisting in laboratory experiment. We also express our sincere thanks to Faculty of Agriculture, Mansoura University, Egypt for the provision of the experimental field.

REFERENCES

Aamil, M.; A. Zaidi and MD.S. KHAN (2004). Fungicidal impact on chickpea-mesorhizobium symbiosis. J. of Environ. Sci. and Health, 39: 779-790.

Abdul-Baki, A. A. and J.D. Anderson (1973). Vigour determination in soybean by multiple criteria. Crop Sci., 10: 31-34.

Agrawal, P. K. (1986). Seed vigor: Concepts and Measurements, In: Seed Production Technology. (Ed. J.P. Srivastava and L.T. Simarsk), ICARDA, Aleppo, Syria pp: 190-198.

Ahrens, D. C.; F. A. Villela and L. Doni Filho (2000). Physiological and industrial of quality white oat seeds (*Avena sativa*) in intermittent drying. Revista Brazilian J. of Seeds, Brasília, 22(2): 12-20.

Arslan, D. and M.M. Özcan (2010). Dehydration of red bell-pepper (*Capsicum annuum* L.): Change in drying behavior, colour and antioxidant content. Food Bioprod. Process, 89: 504-513.

Berti, M.; D.C. Ahrens and D.R. Beusso (2005). Stationary drying of wheat seeds using liquefied petroleum gas. Brazilian J. of Seeds, Brasília, 27(2): 81-86.

Carvalho, N.M. (1994). The Seed Drying. Jaboticabal: FUNEP, 165.

Doyle, P.; M. Stypa; F. Schneidersmann and R. Ramachandran (2001). New generation seed treatment products for canola (*Brassica napus*, B. *campestris*) and mustard (*Sinapsis alba*, *Brassica juncea*). British Crop Prot. Coun. Sym. Proc., 76: 173-180.

Ellis, R.A. and E.H. Roberts (1981). The quantification of ageing and survival in orthodox seeds. Seed Sci. Technol., 9: 373-409.

Franke, L.B.; M.A.P. Torres and R.R. Lopes (2008). Performance of different drying methods and their effects on the physiological quality of grain sorghum seeds (*S. bicolor* (L.) Moench). Revista Brasileira de Sementes, 30(3): 177-184.

Gomez, K. A. and A. A. Gomez (1984). Statistical Procedures for Agricultural Research. 2nd Edn., John Wiley and Sons, New York, USA., ISBN-13: 9780471870920, Pages: 680.

Hagedorn, D.J. (1984). Compendium of pea diseases. The American Phytopathological Society, Saint Paul, Minnesota, USAS. pp. 57.

Hartmann Filho, C.P.; A.L.D. Goneli; T.E. Masetto; E.A.S. Martins and G.C. Oba (2016). The effect of drying temperatures and storage of seeds on the growth of soybean seedlings. J. of Seed Sci., 38(4):287-295.

ISTA (2006). International Rules for Seed Testing. Seed Science and Technology. Basserdorf, Switzerland.

ISTA (2011). International Rule for Seed Testing. The International Seed Testing association (ISTA), Zurichstr. 50, Switzerland. Pp15A-4.

Jensen, B.D.; O.A. Latunde-Data; D. Hudson and J.A. Lucas (1998). Protection of Brassica seedlings against downy mildew and damping-off by seed treatment with CGA 245704, an activator of Systemic Acquired Resistance. Pesticide Science, 52: 63-69.

Kelly, A.F. (1988). Principles of seed growing. In Seed Production of Agricultural Crops, Longman Scientific and Technical, Longman Group UK Limited, 36-55.

Khatiwada, S. (2016). Wheat Seeds Production Technology. Government of Nepal, Lalitpur.

Lamprecht, S.C.; W.F.O. Marasas; P.S. Knox-Davies and F.J. Calitz (1990). Seed treatment and cultivar reaction of annual medicago species and wheat to Fusarium avenaceum and Fusarium graminearum Gr 1: Phytophylactica 22: 201-208.

Maia, M.S. (1995). Drying of annual ryegrass (*Lolium multiflorum* Lam.) Seeds with forced ambient air. Thesis (PhD in Agronomy - Seed Technology) - Faculty of Agronomy Eliseu Maciel, Federal Univ. of Pelotas, Pelotas, RS, 1995.

Mbofung, G.C.Y.; A.S. Goggi; L.F.S. Leandro and R.E. Mullen (2013). Effects of storage temperature and relative humidity on viability and vigor of treated soybean seeds. Crop Sci., 53(3): 1086-1095.

Mantovani, E.C. (2003). Planting and harvesting of sorghum. Sete Lagoas, MG: CNPMS, 5p. (Technical Communiqué, 75).

Munkvold, G.P. and J.K. O'Mara (2002). Laboratory and growth chamber evaluation of fungicidal seed treatments for maize seedling blight caused by Fusarium species. Plant Disease, 86: 143-150.

O'donnell, K.; H.C. Kistler; B.K. Tacke and H.H. Casper (2000). Gene genealogies reveal global phylogeopaphic structure and reproductive isolation among lineages of Fusarium graminearum, the fungus causing wheat scab. Proceeding of the National Academy of Sci., 97: 790-7910.

Pereira, W.A.; S.M.A. Pereira and D.C.F.S. DIAS (2015). Dynamics of reserves of soybean seeds during the development of seedlings of different commercial cultivars. J. of Seed Sci., 37(1): 63-69.

Ruan, S.; Q. Xue and K. Tylkowska (2002). The influence of priming on germination of rice (*Oryza sativa* L.) seeds and seedling emergence and performance in flooded soil. Seed Sci. Tech., 30: 61-67.

Sawant, A. A.; S. C. Patil; S. B. Kalse and N. J. Thakor (2012). Effect of temperature, relative humidity and moisture content on germination percentage of wheat stored in different storage structures. Agric Eng Int: CIGR Journal, 14(2): 110 -118.

Shetty, H.S. (1988). Different types of damages in seeds caused by seedborne fungi. Seed Pathology: Proc CTA Seminar Copenhagen Denmark, 20th-25th June, 53-62.

Smith, J.E.; L. Korsten and T.A.S. Aveling (1999). Evaluation of seed treatment for reducing Colletotrichum dematium on cowpea seed. Seed Sci. and Tech., 27: 591-598.

Snedecor, G.W. and W.G. Cochran. (1980). "Statistical Methods" 7th Ed. The Iowa State Univ. Press, Iowa, USA.

Sun, W.Q. and A.C. Leopold (1995). The Maillard reaction and oxidative stress during aging of soybean seeds. Physiol. Plant., 94: 94-104.

Ullmann, R.; O. Resende; T.H. Chaves; D.E.C. Oliveira and L.M. COSTA (2015). Physiological quality of sorghum seeds submitted to drying under different air conditions. Brazilian J. of Agric. and Environmental Eng., 19(1): 64-69.

Zhang, T. and J.G. Hampton (1999). Does fungicide seed treatment affect bulk conductivity test results. Seed Sci. and Tech. 27: 1041-1045.

تأثير المطهر الفطرى تحت عدة معاملات لتجفيف البذور على جودة البذورالفسيولوجية والأداء الحقلي لبادرات القمح

محمد طه عبد الرحمن زلمه و ناصر السيد عطية

قسم بحوث تكنولوجيا البذور - معهد بحوث المحاصيل الحقلية - مركز البحوث الزراعية - الجيزة - مصر.

أجريت تجربتان إحداهما معملية والأخرى حقلية لدراسة تأثير معاملة تقاوى القمح بثلاثة تركيزات من المطهر الفطري Tendro 40 % FS وثلاث معاملات لتجفيف البذور وتأثير التفاعل بينهما على جودة البذور الفسيولوجية والأداء الحقلي لبادرات القمح (صنف مصر 1) ، وذلك في وحدة بحوث تكنولوجيا البذور بالمنصورة، قسم بحوث تكنولوجيا البذور، معهد بحوث المحاصيل الحقلية، مركز البحوث الزراعية، والمزرعة البحثية بكلية الزراعة – جامعة المنصورة، مصر. أخذت التقاوى في شهر مايو لعام 2017 عند نسبة رطوبة داخلية 16±0,2٪. استخدمت الدراسة ثلاثة تركيزات من المطهر الفطري: 5سم^3/كجم تقاوى كمعاملة قياسية للمطهر الفطري، 3سم^3/كجم تقاوى، 7سم^3/كجم بذرة مقارنة بالتقاوى غير المعاملة. العامل الثاني كان تعريض التقاوى لثلاث معاملات تجفيف: التجفيف الطبيعي لمدة 24 ساعة (4س × 6يوم) الناجم عن التعرض لضوء الشمس غير المباشر ، التجفيف المتقطع لمدة 8 ساعات (4س × 2يوم) الناجم عن مجفف الهواء الساخن والتجفيف السريع أو القصري لمدة 4 ساعات (4س × 1يوم) الناجم عن مجفف الفرن الكهربي. وكانت النتائج كالتالي : أدى معاملة التقاوى بجميع تركيزات المطهر الفطري إلى تعزيز المؤشرات الفسيولوجية للإنبات والبادرات مقارنة بالبذور غير المعاملة (الكنترول)، في حين أظهرت المعاملة بتركيز 5سم^3/كجم تقاوى أكبر زيادة عن معاملة الكنترول مقارنة بالتركيزات الأخرى من المطهر الفطري، حيث كانت 5,4 ٪ من الإنبات المعملي ، 7,4 ٪ من الظهور الحقلي ، 40٪ و 23٪ من الوزن الجاف للبادرات ، 46,2٪ و 27,2٪ من مؤشر قوة البادرات لتجربة الانبات المعملي والأداء الحقلي على التوالي. علي صعيد أخر، اختلف محتوي البذور من الرطوبة لطرق التجفيف المستخدمة بين 11,18٪ ، 11,07٪ و 11٪ وذلك لطرق التجفيف الطبيعية ، المتقطعة بالهواء الساخن والسريعة بمجفف الفرن الكهربي على التوالي. بالإضافة إلي ذلك، أظهر التجفيف السريع أعلى نسبة فقد لرطوبة البذور في أقصر فترة زمنية حيث كانت 4 ساعات ثم 8 ساعات للتجفيف المتقطع وأخيراً 24 ساعة للتجفيف الطبيعي. فضلاً على ذلك، فإن معاملة التجفيف المتقطع أعطت أعلى مؤشرات الإنبات والظهور الحقلي على عكس الطرق الأخرى، حيث كانت 93,5٪ و 87,8٪ من الإنبات المعملي والظهور الحقلي، 0,2جم و 0,17جم من الوزن الجاف للبادرات و 0,193 و 0,150 من مؤشر قوة البادرات لتجربة الانبات المعملي والأداء الحقلي على التوالي. أخيراً، لم يظهر التفاعل بين العوامل تحت الدراسة تأثيراً معنويا كبيرا في أغلب الصفات المدروسة، في حين أظهر التفاعل بين المعاملة (5سم^3/كجم بذرة × التجفيف المتقطع بالهواء الساخن لمدة 8 ساعات) اعلي القيم لجودة البذور الفسيولوجية والأداء الحقلي لبادرات نبات القمح.