



Assessment Regression Relation between Wheat Seed Germination Characteristics Affected Sodium Hypochlorite (NaClO)

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RESEARCH ARTICLE

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ABSTRACT

This research was conducted to assessment effect of different concentrations of sodium hypochlorite along several times on quantitative parameters of wheat seeds affected by *Aspergillus flavus* fungus via factorial experiment according randomized complete block design with four replications. The treatments consisted four concentrations of sodium hypochlorite or NaClO ($C_1=2\%$, $C_2=4\%$, $C_3=6\%$, and $C_4=8\%$) and four time use of NaClO ($T_1=2$, $T_2=5$, $T_3=7$, and $T_4=10$ minutes). Result showed germination percentage and seedling dry weight, seed vigor index and seedling length had positive and significant relationship, but with percentage of abnormal seedling had negative and significant relation. Seedling growth rate with radicle length and plumule length had positive and significant relationship. Germination rate and mean germination time had negative and significant relationship. In general, it can be concluded that higher germination percentage led to increase seedling dry weight and seedling length also higher seed vigor index cause to improve germination percentage especially under environmental contaminants situation. Although lower germination percentage led to increase percentage of abnormal seedling. The higher radicle and plumule length depends to seedlings growth rate. Increasing seed quality and disinfection of the environment leads to an increase germination rate and a decrease mean germination time.

Keywords: *Triticum aestivum*, Seedling dry weight.

INTRODUCTION

Seed separation and cleaning is one of the important processes obtaining pure high quality seed. Purity, germination and disease incidences determine seed quality. Seed cleaning and grading can achieve purity and separate small seeds. The separation can be carried out by the properties of physical, electrical, magnetic, optical, etc. Seed, as it comes

from the field, contains various contaminants like weed seeds, other crop seeds, and inert materials such as stems, leaves, broken seed, and dirt. These contaminants must be removed. The clean seed which is properly handled and stored to provide a high quality planting seed will increase farm production (Fattahi *et al.*, 2017).

Seed germination is an important biological process in growth cycle of the plant species. Successful plant establishment in most cases ends up in acceptable and economical final yield (Movaghatian and Khorsandi, 2013). Studying basic seed emergence requirements will increase the chance of successful plant establishment under different climatic conditions. Rapid, uniform and complete emergence of vigorous seedlings, leads to high grain yield potential by shortening the time from sowing to complete ground cover, allows the establishment of optimum canopy structure to minimize interplant competition, maximize crop yield and provide plants with time and spatial advantages to compete with weeds (Soltani *et al.*, 2001). Seed germination is a critical point in seedling establishment and subsequent plant health and vigor. Seeds may be more sensitive to stresses than mature plants, because of exposure the dynamic environment close to soil surface (Dodd and Donovan, 1999). Germination process includes conveyance of stored minerals to embryo axis and initiating metabolic activities leading to its growth. Tolerance of plants in these two phases of plants life plays a significant role in their stand establishment which results in higher yields (Almasouri *et al.*, 2001). Poor plant establishment is a common cause of reduction in plant yields in arid and semi-arid areas (Harris *et al.*, 2001). This research was conducted to evaluate regression relation between seed germination parameters under different concentration of sodium hypochlorite.

MATERIALS AND METHODS

Treatment Information

This research was conducted to assessment effect of different concentrations of sodium hypochlorite along several times on quantitative parameters of

wheat seeds infected by *Aspergillus flavus* fungus via factorial experiment according randomized complete block design with four replications. The treatments consisted four concentrations of sodium hypochlorite or NaClO ($C_1=2\%$, $C_2=4\%$, $C_3=6\%$, and $C_4=8\%$) and four time use of NaClO ($T_1=2$, $T_2=5$, $T_3=7$, and $T_4=10$ minutes).

Measured Traits

Germination percentage was determined by following formula (Scott *et al.*, 1984):

Equ. 1. $GP (\%) = Ni/N \times 100$. Ni: Number of germinated seed, N: Total number of seed.

Germination rate and mean germination time was estimated by following formula (Panwar and Bhardwaj, 2005):

Equ.2. Germination rate = $\Sigma (n_i/t_i)$

n_i : The number of germinated seeds interval two consecutive counts, t_i : Number of days after starting germination

Equ.3. Mean germination time =

$\Sigma (n_i \times t_i) / \Sigma n_i$. n_i : Total number of seed

The following equation was used to calculate seedling growth rate (AOSA, 1983):

Equ. 4. $Y = W/X - (a+b)$

Y= seedling growth rate, X= seed number, a= number of abnormal seedling, b= Number of death seeds, W= total dry weight of seedlings (mg).

Seed vigor index estimated by following formula (Abdul-baki and Anderson, 1975):

Equ.5. $Vi = [GP (\%) \times MSH] / 100$

Vi= Seed vigor index, GP= Germination percent, MSH= Mean seedling height (Plumule and Radicle). In order to determine the seedling dry weight, the natural seedlings were separately placed in oven at 80°C for 24 hours and after dry weight of each seedling was calculated in mg. Dry weight was measured by using a scale of 0.0001 gr.

Statistical Analysis

Analysis of variance was done by SAS software (Ver.9.1) and mean comparison was done by Duncan multiple range test (DMRT) at 5% probability level. Regression relation between measured traits was determined by Minitab software (Ver.15).

RESULTS AND DISCUSSION

Analysis of variance (ANOVA)

According result of analysis of variance effect of different concentration of sodium hypochlorite (NaClO) on germination percentage, germination rate,

seedling growth rate, seed vigor index, seedling length, percentage of abnormal seedling, radicle length, plumule length was significant at 5% probability level but on seedling dry weight was significant at 1% probability level and on mean germination time was not significant. Also effect of different time of use of NaClO on all measured traits was significant at 5% probability level but on seedling dry weight was significant at 1% probability level. Interaction effect of treatments on all measured traits (instead mean germination time) was significant (Table 1).

Table 1. Analysis of variance of the effect of different concentration and time of application sodium hypochlorite on measured traits

Treatments	Germination percentage	Germination rate	Mean germination time	Seedling growth rate	Seed vigor index
Different concentration of NaClO (A)	*	*	ns	*	*
Different time of use of NaClO (B)	*	*	*	*	*
A*B	*	*	ns	**	**
CV (%)	7.6	5.65	2.98	3.69	3.13

ns, * and **: non-significant, significant at 5 and 1% levels, respectively.

Continue table 1.

Treatments	Seedling length	Seedling dry weight	Percentage of abnormal seedling	Radicle length	Plumule length
Different concentration of NaClO (A)	*	**	*	*	*
Different time of use of NaClO (B)	*	**	*	*	*
A*B	**	**	**	*	*
CV (%)	2.69	3.68	3.13	4.55	8.1

ns, * and **: non-significant, significant at 5 and 1% levels, respectively.

Regression relation between measured traits

The linear regression model was used for expression of the seed germination parameters according to independent factors variation. The linear regression model showed a high correlation coefficient. Germination percentage and seedling dry weight, seed vigor index and seedling length had positive

and significant relationship, but with percentage of abnormal seedling had negative and significant relation (Fig. 1, 2, 3 and 4). Seedling growth rate with radicle length and plumule length had positive and significant relationship (Fig. 5 and 6). Germination rate and mean germination time had negative and significant relationship (Fig. 7).

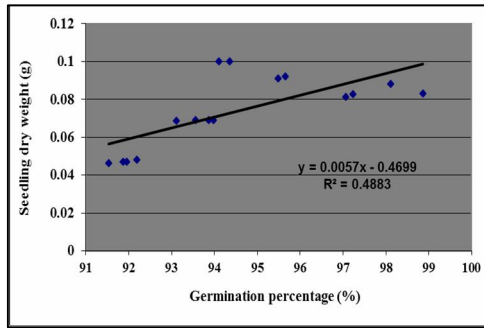


Fig.1. Regression relation between germination percentage and seedling dry matter.

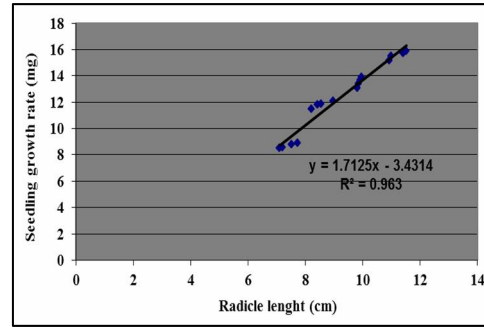


Fig.5. Regression relation between radicle length and seedling growth rate.

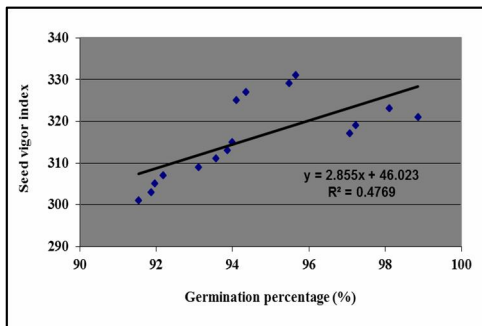


Fig.2. Regression relation between germination percentage and seed vigor index.

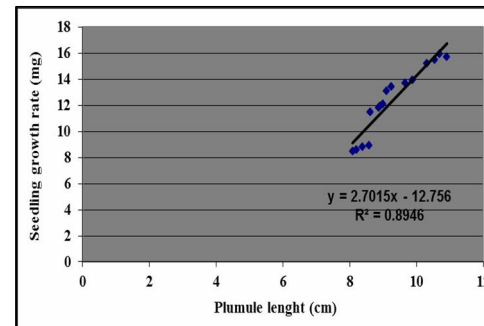


Fig.6. Regression relation between plumule length and seedling growth rate.

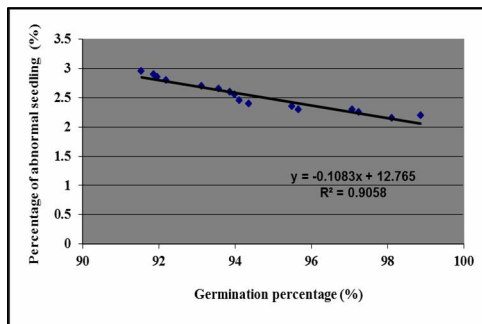


Fig.3. Regression relation between germination percentage and percentage of abnormal seedling.

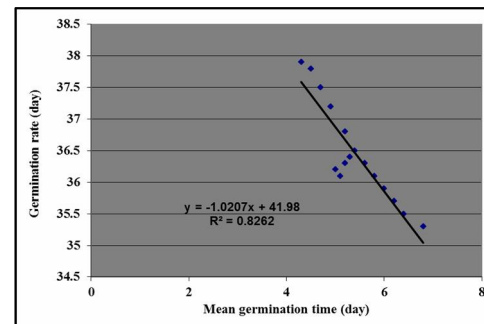


Fig.7. Regression relation between mean germination time and germination rate.

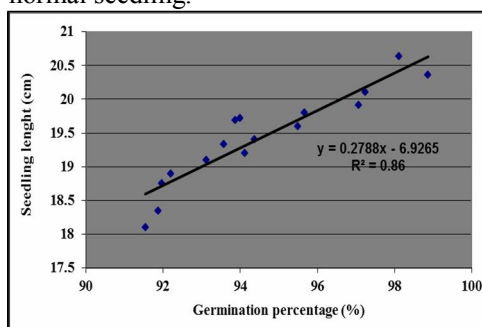


Fig.4. Regression relation between germination percentage and seedling length.

Germination rate is one of the most important indicators to evaluate the tolerance in plant (Kafi, 2005). Seed germination and seedling growth traits are extremely important factors in determining yield (Rauf *et al.*, 2007). Dhandas *et al.* (2004) indicated that seed vigor index and plumule length are the most sensitive traits to drought stress. The seed vigor index shows the percentage and germination potential, so the lower seed quality led to decrease

the germination percentage and seed vigor index (Mohssen Nasab *et al.*, 2010). Regression models incorporating more parameters can produce more precise estimates. (Shafii and Price, 2001). Such regression models have been used to explain development rate in many crops (Kamkar *et al.*, 2012).

CONCLUSION

Higher germination percentage led to increase seedling dry weight and seedling length also higher seed vigor index cause to improve germination percentage especially under environmental contaminants situation, although lower germination percentage led to increase percentage of abnormal seedling.

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