

Predicting Emergence and Seedling Growth of Barley Seed by Using Seed Vigour Indices

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Abstract

Predicting emergence and seedling growth of barley BRB. 2 and BRB. 9 varieties was carried out at department of Agronomy, Faculty of Agriculture, Chiang Mai University. Sample of BRB. 2 and BRB. 9 barley seed were artificially aged by storing in 100% RH at 40°C for 0, 2, 4, 6 and 8 day to provide variability in seed quality for the experiment. Seed vigor were evaluated by standard germination test, cold germination test, plumule length test, seedling dry weight determination, electroconductivity test, tetrazolium test and accelerated aging test along with field emergence test. Linear correlation among seed vigor indices and field emergence were significant at $P \leq 0.05$. Using cold germination test (X_1), electroconductivity test (X_2), germination index (X_3), germination 7th day test (X_4), germination 4th day (X_5), tetrazolium test (X_6), accelerated aging test (X_7), seedling dry weight 4th day (X_8), seedling dry weight 7th day (X_9) cold germination index (X_{10}) and plumule length test (X_{11}) as the predictors in stepwise regression analysis to predict field emergence end up with the best equation for BRB. 2 was Eq.1 and BRB. 9 was Eq.2

$$Y = 0.5492X_1 - 0.0975X_2 + 1.075X_3 + 0.071X_4 + 0.4487X_5 - 0.049X_6 \text{ (Eq.1)}$$

$$(R^2 = 0.9929)$$

$$Y = 0.611X_1 + 0.235X_3 + 0.242X_4 - 0.086X_5 + 0.066X_7 \text{ (Eq.2)}$$

$$(R^2 = 0.9984)$$

However, using only cold germination test as a predictor gave equally good which were Eq.3 for BRB. 2 and Eq.4 for BRB. 9

$$Y = 1.072X_1 \text{ (Eq.3)}$$

$$(R^2 = 0.9840)$$

$$Y = 1.0208X_1 \text{ (Eq.4)}$$

$$(R^2 = 0.9926)$$

Keywords: Germination, Emergence, Seed Vigor, Equation

Introduction

The results from seed quality testing in the seed-testing laboratory sometimes differ from the field test. Preventing the unprecised results could be done by many ways. One of the suggested method is to predict the seed qualities by analyzing all kinds of physiological, biochemical and environmental data from the seed lot to predict the quality of the seed (**Edje and Burris, 1971; Ching et al.,1977; Kim et al.,1989**). Therefore, this experiment was conducted to determine the correlation of various vigor tests method both in the laboratory and in the field by using correlation equation.

Material and Methods

Two varieties of Barley BRB.2 and BRB.9 were multiplied as foundation seed at Faculty of Agriculture research station Chiang Mai Thailand. 15 Kg. Seed sample was taken and each of the working sample was 1 Kg. The sample seeds were kept in the basket containers, stored in simulated environment of 100% RH and were sampled for following testing.

Viability test (ISTA, 1985) :

Standard Germination test
Tetrazolium test

Vigor test (ISTA, 1985) :

Plumule length test
Vigor index and Seedling dry weight determination
Cold germination test
Electroconductivity test
Accelerated aging test

Field emergence test (ISTA, 1985)

Statistical analysis Data was analyzed using model specific for a CRD (**Steel and Torrie, 1960**) and Multiple regression analysis by Stepwise

Result and Conclusion

Linear correlation among seed vigor indices and field emergence were significant at $P \leq 0.05$. Using cold germination test (X_1), electroconductivity test (X_2), germination index (X_3), germination 7th day test (X_4), germination 4th day (X_5), tetrazolium test (X_6), accelerated aging test (X_7), seedling dry weight 4th day (X_8), seedling dry weight 7th day (X_9) cold germination index (X_{10}) and plumule length test (X_{11}) as the predictors in stepwise regression analysis to predict field emergence end up with the best equation for BRB. 2 was $Y = 0.5492X_1 - 0.0975X_2 + 1.075X_3 + 0.071X_4 + 0.4487X_5 - 0.049X_6$ ($R^2 = 0.9929$) and BRB. 9 was $Y = 0.611X_1 + 0.235X_3 + 0.242X_4 - 0.086X_5 + 0.066X_7$ ($R^2 = 0.9984$). However, using

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only cold germination test as a predictor gave equally good which were $Y = 1.072X_1 (R^2 = 0.9840)$ for BRB. 2 and $Y = 1.0208X_1 (R^2 = 0.9926)$ for BRB. 9.

References

- Anderson, J.D., (1970). Physiological and biological differences in deteriorating barley seed. *Crop Science*.10, pp.36-39.
- Ching I.M., Hedtke S., Boulger M.C. and Kronstad W.E., (1977). Correlation of field emergence rate and seed vigor criteria in barley cultivars. *Crop Science*.17, pp.312-314.
- DasGupta, P.R. and Austenson H.M., (1973). Analysis of interrelationships among seedling vigor, field emergence and yield in wheat. *Agronomy Journal*.65, pp.417-422.
- Delouche, J.D. and Caldwell W.P., (1980). Seed vigor and vigor tests. *Proceeding of the Association of Official Seed Analysis* .50, pp124-129.
- Edje, O.T. and Burris J.S., (1971). Effect of soybean seed vigor on field performance. *Agronomy Journal*. 63, pp. 536-538.
- ISTA.(1985). International rules of seed testing Rules 1985. *Seed Science and Technology Journal*.13, pp.356-513.
- Kim, S.H., Bin Y.H. and Choe, Z.R., (1989). The use of multiple seed vigor indices to predict field emergence and grain yield of naked and malting barley. *Korean Journal of Crop Science*. 34(2), pp.134-141.
- Steel R.G.D.and Torrie, J.H., (1960). *Principle and procedure of statistical*. Mc Graw-Hill Comp.Inc. New York.

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Table 1. Linear correlation of various vigor tests and field emergence of Barley variety BRB.2

Method	Linear correlation with Field emergence by Time of storage(day)				
	0	2	4	6	8
Germination 4 Th Day (%)	0.438 NS	-0.350 NS	-0.132 NS	-0.626 NS	0.992 **
Germination 7 Th Day (%)	-0.307 NS	0.881 *	0.662 NS	0.683 NS	0.998 **
Germination Index	0.197 NS	0.183 NS	-0.064 NS	0.444 NS	0.994 **
Plumule length (cm.)	0.896 *	0.643 NS	0.579 NS	0.340 NS	0.276 NS
Seedling dryweight 4 Th Day (g/100seeds)	0.221 NS	0.844 NS	0.550 NS	0.557 NS	0.921 **
Seedling dryweight 7 Th Day (g/100seeds)	0.221 NS	0.844 NS	0.550 NS	0.557 NS	0.921 **
Cold germination (%)	0.899 *	0.820 *	0.866 *	0.909 *	0.896 *
Cold germination index	0.406 NS	0.345 NS	-0.533 NS	0.918 *	0.878 *
Electroconductivity (μhos/g)	-0.879 *	-0.901 *	-0.799 NS	-0.077 NS	-0.442 NS
Tetrazolium index	-0.238 NS	-0.313 NS	0.463 NS	0.681 NS	0.356 NS
Accelerate aging test (%)	-0.920 *	0.883 *	0.990 NS	-0.681 NS	0.088 NS

NS : non- significant * : significant(<0.05) ** : significant(P<0.01)

Table 2. Linear correlation of various vigor tests and field emergence of Barley variety BRB.9

Method	Linear correlation with Field emergence by Time of storage(day)				
	0	2	4	6	8
Germination 4 Th Day (%)	0.541 NS	0.025 NS	-0.138 NS	-0.005 NS	0.435 NS
Germination 7 Th Day (%)	0.641 NS	0.960 **	0.541 NS	0.883 *	0.964 **
Germination Index	0.986 **	0.998 **	0.989 **	0.884 *	0.997 **
Plumule length (cm.)	0.834 NS	0.894 *	0.806 NS	0.650 NS	0.301 NS
Seedling dryweight 4 Th Day (g/100seeds)	0.228 NS	0.334 NS	0.843 NS	0.821 NS	0.993 **
Seedling dryweight 7 Th Day (g/100seeds)	0.795 NS	0.816 NS	0.352 NS	0.293 NS	0.938 *
Cold germination(%)	0.984 **	0.991 **	0.993 **	0.991 **	0.940 *
Cold germination index	-0.717 NS	-0.157 NS	0.775 NS	0.956 *	0.927 *
Electroconductivity (μhos/g)	-0.884 *	-0.932 NS	-0.682 NS	-0.611 NS	0.008 NS
Tetrazolium index	0.399 NS	-0.275 NS	-0.406 NS	-0.637 NS	-0.753 NS
Accelerate aging test(%)	0.950 NS	0.925 *	0.194 NS	0.677 NS	0.388 NS

NS : Non- significant * : Significant(<0.05) ** : Highly significant(P<0.01)

Table 3. Regression Analysis of various vigor tests and field emergence of Barley variety BRB.2

Method	R ²	Predicting equation of field emergence
Cold germination (X ₁)	0.9840	Y=1.0726 X ₁
Electroconductivity(X ₂)	0.9869	Y=0.9880 X ₁ -0.0722X ₂
Germination Index(X ₃)	0.9893	Y=16.4696+0.6914 X ₁ -0.0879 X ₂ +0.3468X ₃
Germination 7 Th Day(X ₄)	0.9922	Y=0.6153X ₁ -0.0640X ₂ -0.0746 X ₃ +0.3770 X ₄
Germination 4 Th Day(X ₅)	0.9928	Y=0.6033X ₁ -0.0644X ₂ +0.1947X ₃ +0.3070 X ₄ -0.1249X ₅
Tetrazolium index(X ₆)	0.9936	Y=0.5492X ₁ -0.09757X ₂ +1.0750 X ₃ +0.0712X ₄ +0.448 X ₅ -0.0491X ₆

Table 4. Regression Analysis of various vigor tests and field emergence of Barley variety BRB.9

Method	R ²	Predicting equation of field emergence
Cold germination (X ₁)	0.9926	Y=1.0208 X ₁
Germination Index(X ₃)	0.9962	Y=0.7329X ₁ +0.0466X ₃
Germination 7 Th Day(X ₄)	0.9973	Y=0.6012X ₁ +0.2875X ₃ +0.1939X ₄
Germination 4 Th Day(X ₅)	0.9980	Y=0.5670X ₁ +0.2551X ₃ +0.3525X ₄ -0.10X ₅
Accelerate aging test(X ₇)	0.9984	Y=0.6612X ₁ +0.2352X ₃ +0.2421X ₄ -0.0862X ₅ +0.066X ₇