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EVALUATION OF MUNG BEAN GENOTYPES FOR RESISTANCE TO FIELD AND STORAGE DETERIORATION

EVALUASI KETAHANAN GENOTIPE KACANG HIJAU TERDAHAP DERAAN CUACA DI LAPANG DAN DI PENYIMPANAN

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ABSTRACT

Humid tropical environments are very conducive to rapid seed deterioration in the field and in storage. The objectives of these studies were to (1) determine the role of mung bean seed coat characteristics on resistance to field and storage deterioration, and (2) to relate resistance to field deterioration with resistance to storage deterioration. Nine mung bean genotypes with different characteristics of seed coats were grown in research plots at Agriculture Faculty, Bengkulu University on November 2002 and subjected to (1) incubator weathering method to determine their difference in resistance to field deterioration for experiment 1, and (2) ambient storage method to determine their difference in resistance to storage deterioration for experiment 2. For each experiment, the treatment was arranged in a completely randomized design with three replications. After treated with incubator weathering and ambient storage methods, each genotype from each replicate was separately subjected to seed viability and vigor evaluation. The results showed that incubator weathering and ambient storage methods revealed their genotypic differences in resistance to field and storage deterioration respectively and the resistance was more attributed to seed coat permeability than seed size. The seed coat permeability, which was inversely related to seed coat lignin content ($r = -0.75$ $P<0.05$), was correlated with the two seed quality indicators following incubator weathering and following ambient storage. For the incubator weathering, the correlation coefficient (r) between seed coat permeability with seed germination was – 0.70 ($P<0.05$) and with electrolyte conductivity was 0.75 ($P<0.05$). For ambient storage, the correlation coefficient (r) between seed coat permeability with seed germination was – 0.77 ($P<0.05$), and with electrolyte conductivity was 0.77 ($P<0.05$). A significant correlation was also observed between the two seed quality indicators following incubator weathering and following ambient storage. The correlation coefficient (r) between seed germination following incubator weathering and following ambient storage was 0.85 ($P<0.05$) and between electrolyte conductivity following incubator weathering and following ambient storage was 0.73 ($P<0.05$). This indicated that genotypes resistant to field deterioration as evaluated by the incubator weathering method were also resistant to storage deterioration as evaluated by the ambient storage method or vice versa and they were seeds of Bhakti and Gelatik.

Key words: mung bean seed, incubator weathering, ambient storage, seed coat permeability, seed viability, vigor

ABSTRAK

Kelembaban dan suhu harian yang tinggi dianggap sebagai penyebab kemunduran mutu benih kacang hijau. Untuk mengetahui sampai sejauhmana peranan keduanya, dua percobaan yang berbeda dilakukan dengan tujuan (1) menentukan peranan kulit benih pada kemunduran mutu benih kacang hijau selama deraan cuaca di lapang dan di penyimpanan, dan (2) mencari kedekatan hubungan antara ketahanan benih kacang hijau terhadap deraan cuaca di lapang dan di penyimpanan. Kesembilan genotipe ditanam di petak percobaan Fakultas Pertanian Unib pada bulan November 2002. Pada percobaan I, sembilan genotipe kacang hijau didera dengan metode *incubator weathering* dengan cara polong dimasukkan dalam inkubator pada suhu 30^0C dan kelembaban 90% selama 10 hari. Pada percobaan II, mereka didera dengan metode *ambient storage* dengan cara benih disimpan selama delapan bulan pada suhu kamar ($30\ ^0$C) dan kelembaban 75%. Pada setiap percobaannya, perlakuan ditata dalam rancangan acak lengkap dengan tiga ulangan. Setelah selesai diperlakukan, benihnya dievaluasi kualitasnya. Hasilnya menunjukkan bahwa metode *incubator weathering* dan *ambient storage* dapat membedakan derajat ketahanan setiap genotipe dan ketahanan itu lebih ditentukan oleh permeabilitas kulit benih daripada ukuran benih. Permeabilitas kulit benih, yang berkorelasi terbalik dengan kandungan ligninnya (r = - 0.75 P<0.05), memiliki korelasi dengan dua indikator mutu benih yang digunakan baik pada percobaan 1 maupun percobaan 2. Pada percobaan 1, koefisien korelasi (r) antara permeabilitas kulit benih dengan viabilitasnya sebesar – 0.70 (P<0.05) dan dengan daya hantar listriknya sebesar 0.75 (P<0.05). Pada percobaan 2, koefisien korelasi (r) antara permeabilitas kulit benih dengan viabilitasnya sebesar – 0.77 P<0.05) dan dengan daya hantar listriknya sebesar 0.77 (P<0.05). Korelasi yang tinggi juga diperlihatkan oleh dua indikator mutu benih baik setelah *incubator weathering* maupun setelah *ambient storage*. Koefisien korelasi antara viabilitas benih setelah *incubator weathering* dan setelah *ambient storage* sebesar 0.85 (P<0.05) dan antara daya hantar listrik setelah *incubator weathering* dan setelah *ambient storage* sebesar 0.73 (P<0.05). Hal ini menunjukkan bahwa genotipe-genotipe yang tahan terhadap deraan cuaca di lapang juga tahan terhadap deraan cuaca di penyimpanan ataupun sebaliknya dan mereka ialah genotipe Bhakti dan Gelatik.

Kata kunci: kacang hijau, deraan cuaca, penyimpanan, permeabilitas kulit benih, viabilitas, vigor

INTRODUCTION

A humid tropical climate characterized by high temperature and high relative humidity is very conducive to rapid deterioration of mung bean seed [*Vigna radiata* (L.) Wilczek]. During the deterioration, its vigor as well as its viability can decrease rapidly, making it impossible for the farmers to use their own seed for planting in the next season due to its low quality.

Deterioration of seed in the field prior to harvest is usually referred to as field deterioration or as preharvest weathering or as field weathering and in storage is called storage deterioration or postharvest weathering. Several studies indicated that high temperature, humidity and precipitation play a critical role on pre and post harvest weathering. (Keigly and Mullen, 1986; TeKrony *et al.*, 1980).

Genotypic differences in resistance to field and storage deterioration have been reported in soybeans (Dassou and Kueneman, 1984; Marwanto, 2004). Marwanto (2004) further reported that their different resistance was able to be revealed with incubator weathering method for resistance to filed deterioration and with ambient storage method for resistance to storage deterioration. He also concluded that the genotypes resistant to field deterioration were also resistant to storage deterioration or vice versa.

Several studies on resistance to seed deterioration indicated that the seed coat characteristics plays an important role on resistance of seeds to deterioration (Dassou and Kueneman, 1984; Horlings *et al.*, 1991) and its 'relative' impermeability to water absorption is the main factor involved (Kuo, 1989).

Dassou and Kueneman (1984) used different seed coat color to evaluate soybean genotypes for resistance to field and storage deterioration. They concluded that black-seeded genotypes were more resistant to the deterioration than yellow-seeded genotypes. In the same study, they also reported that seed coat permeability played an important role on resistance to the deterioration.

Most reports on soybeans also emphasized that small-seeded genotypes were more resistant to field and storage deterioration than large-seeded genotypes (Dassou and Kueneman, 1984; Marwanto, 2004). However, these studies were not able to determine if the resistance exhibited by small-seeded genotypes was as a result of their seed coat characteristic.

It was reported that mung bean seeds differred genotypically in resistance to field deterioration and the resistance mechanism was associated with impermeable seed coat (Marwanto, 2007). Using the same genotypes for another study, he also reported that a significant difference in resistance to storage deterioration was also observed among them and ambient storage method at 8 months revealed their different resistance. However, he did not conclude that the genotype resistant to field deterioration was also resistant to storage deterioration or vice versa.

The objective of this study was (1) to determine the role of seed coat characteristics on resistance to field and storage deterioration, and (2) to relate resistance to field deterioration with resistance to storage deterioration.

MATERIAL AND METHODS

Experiment 1. evaluation of mung bean genotypes for resistance to field deterioration

Nine mung bean genotypes with different seed coat characteristics (Table 1) were grown on November 2002 at the Agriculture Faculty Research Plot in a completely randomized design with three replications. Each genotype was planted in a single row 20 m long with 1m between rows and 20 cm between plants within a row. At physiological maturity (about 90% of the pods had turned brown) one hundreed pods form each genotype were hand harvested and their seed was evaluated for resistance to field deterioration with the incubator weathering method as recommended by Marwanto (2004) for soybeans. The rest of the pods were left in the field for experiment 2. This method was conducted by subjecting the harvested pods to 30 ^{0}C and 90% relative humidity (RH) for 7 days in an incubator. In the incubator the pods from each genotype were arranged in a completely randomized design with three replications. After 7 days of weathering the pods were removed from the incubator, force air dried to approximately 12% moisture content at 30 ^{0}C for 5 days and hand-threshed. To determine their resistance to field deterioration, after being subjected to the incubator weathering method the seeds were then evaluated for viability by standard germination test, vigor by accelerated aging test, and leachate conductivity by electrolyte conductivity test.

Experiment 2. evaluation of mung bean genotypes for resistance to storage deterioration

When the rest of mung bean plants used at experiment 1 reached harvest maturity (about 90% of the pods had turned dark black), 100 pods were harvested by hand stripping. Seed moisture content at this stage had dropped to about 20%. The pods were then dried with heated air (<35 ^{0}C) to reduce moisture content to 10-12% for threshing. The dried pods contained in jute bags were threshed by flailing and the seeds were separated from the pod walls and another plant parts by sieving. Sieving (round hole) was used to eliminate the small, immature and insect damaged seeds. Selected mung bean seed samples were then evaluated their resistance to storage deterioration with the ambient storage method as recommended by Marwanto (2007). This method was conducted by storing the seeds in a chamber at 30 ^{0}C and 75% RH for a period of 8 months. Before storage, seed moisture content of each genotype was adjusted to about 10%. Then, the seeds with similar initial physiological quality (>90%), as evaluated by the standard germination test, were stored in a wooden humidity chamber of about 0.6 m^3 capacity with a saturated sodium chloride solution in the bottom well to maintain 75% RH for 8 month. Seeds of each genotype were contained in plastic mesh pouches and placed in the humidity chamber in a completely randomized design with three replications. The humidity chamber was positioned in a closed room with temperature maintained at 30 ^{0}C. To determine their resistance to storage deterioration, at the end of being subjected to the ambient storage method the seeds were then evaluated for viability by standard germination test, vigor by accelerated aging test, and leachate conductivity by electrolyte conductivity test.

Procedures for evaluating viability, vigor and seed coat characteristics

In standard germination test, fifty seeds from each replication were place on moist paper towels which were rolled and placed inside plastic bags and kept at a room temperature. Germination seeds were counted after 4 and 7 days. The number of germinated seeds were expressed as a percentage of the total.

In accelerated aging test, seeds were subjected to a period of accelerated aging, 42^{0}C and near 100% RH, for 48 hours prior to standard germination test. Fifty seeds from each replication were placed on a wire mesh tray of 20X5X2.5cm. The tray was placed inside a plastic box of 30X10X5cm The box was filled with 100ml of water. A 10-mm gap was maintained between the water surface and the seed tray. The box was covered with airtight lid and kept in oven at 42 ^{0}C for 48 hours. After aging, seeds were taken out of the aging box and subjected to standard germination test.

In electrolyte conductivity test, a weighed sample of twenty five seeds were soaked in 40 ml distilled water for 12 hours at a room temperature. The electrical conductivity of seed leakage was determined with a Cole-Parmer conductivitimeter (Chicago, Illinois) and was expressed in mmhos cm^{-1} g^{-1}.

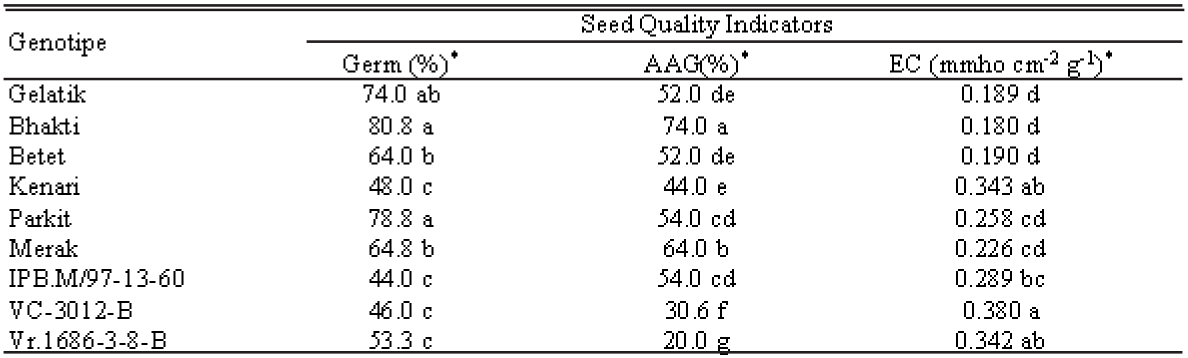
The seed coat lignin content was determined using 1.0 g of seed coat tissue for each genotype by the sulphuric oxidation method (Van Soest and Wine, 1968). To determine seed coat permeability, for each genotype one set of two replicates of 10 g of seed were randomly drawn from seed fraction of the mung bean sample. Initial seed moisture content of each genotype was adjusted to about 10%. Seed coat permeability was determined following 2 hours of submersion in distilled water and expressed in g g^{-1} h^{-1}.

Table 1. Selected mung bean genotypes used in this study with their lignin content expressed as % ADL (acid delinted lignin), seed coat permeability (P), and seed weight

Genotipe	Lignin Content * (%ADL)	P^* (g g^{-1} hr^{-1})	100-Seed Weight ** (g)
Gelatik	0.062 ab	0.029 d	4.74
Bhakti	0.070 a	0.008 e	4.34
Betet	0.054 bc	0.071 a	3.82
Kenari	0.010 fg	0.047 bc	5.61
Parkit	0.050 cd	0.039 c	5.07
Merak	0.070 a	0.043 c	6.64
IPB.M/97-13-60	0.042 d	0.056 b	6.27
VC-3012-B	0.016 ef	0.068 a	5.46
Vr.1686-3-8-B	0.007 g	0.042 c	4.00

* Number within the same column followed the same small letter differed significantly by least significant difference (P = 0.05); **. Weight in grams of 100 seeds at 12% moisture

Table 2. Influence of incubator weathering of mung bean pods of various genotypes on germination (Germ), accelerated aging germination (AAG), and electrolyte conductivity (EC)



Genotipe	Seed Quality Indicators		
	Germ (%)*	AAG(%)*	EC (mmho cm^{-2} g^{-1})*
Gelatik	74.0 ab	52.0 de	0.189 d
Bhakti	80.8 a	74.0 a	0.180 d
Betet	64.0 b	52.0 de	0.190 d
Kenari	48.0 c	44.0 e	0.343 ab
Parkit	78.8 a	54.0 cd	0.258 cd
Merak	64.8 b	64.0 b	0.226 cd
IPB.M/97-13-60	44.0 c	54.0 cd	0.289 bc
VC-3012-B	46.0 c	30.6 f	0.380 a
Vr.1686-3-8-B	53.3 c	20.0 g	0.342 ab

*. Number within the same column followed the same smal letter differed significantly by least significant difference (P = 0.05)

Statistical 1nalysis

Statistical analysis was separately conducted for each experiment. The data obtained from seed quality variables were analyzed using the analysis of variance. Means, when significantly different, were separated by the Least Significant Difference at the 0.05 level of probability. Correlation analyses was conducted to determine the relationship between seed coat characteristics with resistant to field and storage deterioration, and between resistant to field and storage deterioration.

RESULTS AND DISCUSSION

Experiment 1. Evaluation of mung bean genotypes for resistance to field deterioration

An extreme seed deterioration of nearly all genotypes occurred during accelerated aging of incubator weathering pods due to a long exposure of their seeds to unfavorable temperature and RH and masked their differences in resistance to the weathering as shown by a wide difference between the maximum and minimum values of accelerated aging germination (Table 2). Therefore, only seed germination and electrolyte conductivity values were used as indicators for further seed quality evaluation following incubator weathering and for further discussion the effects of the treatment on mung bean seed viability and vigor. The deleterious effects of unfavorable conditions on reducing accelerated aging germination were also reported by Marwanto (2003a) for soybeans.

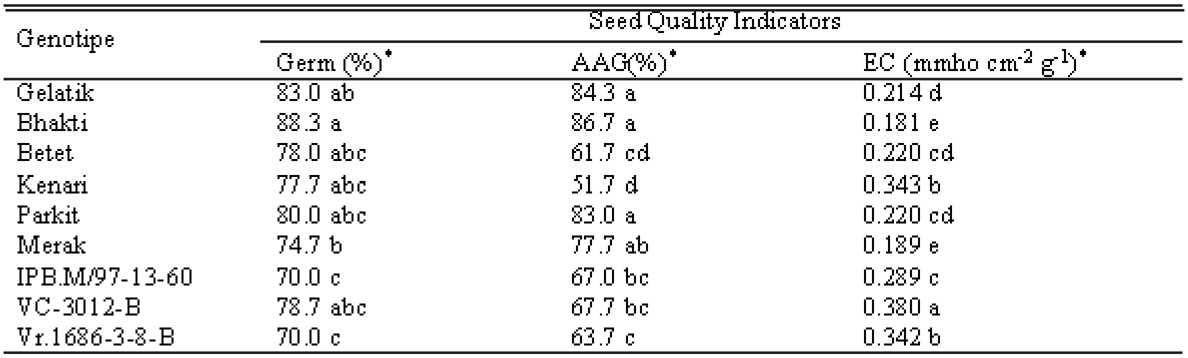
The mean germination and electrolyte conductivity values were significantly different among genotypes (Table 2). This indicted that a different resistance to incubator weathering among them existed. Resistant genotypes were indicated by higher seed germination and lower electrolyte conductivity values than susceptible genotypes. The similar result was also reported by Dassou and Kueneman (1984) and Marwanto (2004) for soybeans. Seeds of Bhakti and Gelatik were identified as being more resistant to the weathering than the others.

Table 3. Correlations among seed coat lignin content, seed coat permeability, germination, accelerated aging germination, and electrolyte conductivity in mung bean seeds subjected to incubator weathering

	Seed coat permeability	Germination	Accelerated aging germination	Electrolyte conductivity
Seed coat lignin content	-0.75*	0.77*	0.36 ns	-0.92**
Seed coat permeabiltity		-0.70	-0.39 ns	0.75*
Germination			0.23 ns	-0.56*
Accelerated aging germination				-0.23 ns

*, ** significant at P=0.05 and 0.01, respectively. ns = nonsigficant

Table 4. Influence of ambient storage at 8 months on germination (Germ), accelerated aging germination (AAG), and electrolyte conductivity (EC) of mung bean seeds.



Genotipe	Seed Quality Indicators		
	Germ (%)*	AAG(%)*	EC (mmho cm^{-2} g^{-1})*
Gelatik	83.0 ab	84.3 a	0.214 d
Bhakti	88.3 a	86.7 a	0.181 e
Betet	78.0 abc	61.7 cd	0.220 cd
Kenari	77.7 abc	51.7 d	0.343 b
Parkit	80.0 abc	83.0 a	0.220 cd
Merak	74.7 b	77.7 ab	0.189 e
IPB.M/97-13-60	70.0 c	67.0 bc	0.289 c
VC-3012-B	78.7 abc	67.7 bc	0.380 a
Vr.1686-3-8-B	70.0 c	63.7 c	0.342 b

*. Number within the same column followed the same small letter differed significantly by Least Significant Difference (P = 0.05)

Table 5. Correlations among seed coat lignin content, seed coat permeability, germination, accelerated aging germination, and electrolyte conductivity in mung bean seeds subjected to ambient storage

	Seed coat permeability	Germination	Accelerated aging germination	Electrolyte conductivity
Seed coat lignin content	-0.75*	0.86**	0.53*	-0.96**
Seed coat permeabiltity		-0.77*	-0.39 ns	0.77*
Germination			0.23 ns	-0.70*
Accelerated aging germination				-0.50 ns

*, ** significant at P=0.05 and 0.01, respectively. ns = nonsigficant

Seed coat permeability well correlated with the two seed quality indicators. A strong negative correlation between seed coat permeability with seed germination (r = - 0.70 P<0.05) and with electrolyte conductivity (r = 0.75 P<0.05) was observed (Table 3). This indicated that it was involved in the mechanism of weathering resistance. Slow imbiber genotypes or also called genotypes with slow imbibitions seed coat type as indicated by low seed coat permeability value (Table 1) were more resistant to the weathering treatment than those with rapid imbiber genotypes. The similar result was also reported by Marwanto (2004) for soybeans. Among the slow imbiber genotypes, seeds of Bhakti and Gelatik were identified as being more resistant to the weathering than the others.

Seed coat lignin content also played a significant role on reducing seed deterioration during incubator weathering as shown by its positive correlation with seed germination *(*r = 0.77 P<0.05) and negative correlation with electrolyte conductivity (r = - 0.92 P<0.01) (Table 3). The positive effect of seed coat lignin content on reducing seed deterioration during the weathering was related to its impermeability effect on seed coat (Panobianco *et al.*, 1999). They further explained that lignin occurrence in the seed coat exerts an important effect on the capacity of absorption of water throughout seed coat. In this study a significant negative correlation (r = - 0.75 P<0.05) was found between seed coat lignin content and seed coat permeability. Thus, this result was in agreement with the reason proposed by Panobianco *et al.* (1999).

Seed size appeared to play a role in resistance to incubator weathering. Among the genotypes tested in this study seed of Bhakti with the highest seed viability and the lowest electrolyte conductivity values had relatively small seeds, but other small-seeded genotypes such as Betet and Vr.1686-3-8-B had a poor seed vigor. This result emphasized that genotypes with good quality had relatively small seeds, but not all small-seeded genotypes had good seed quality. The similar result was also reported by Dassou and Kueneman (1984) for soybeans.

The superior resistance of small-seeded genotype such as Bhakti to incubator weathering was obviously related to seed coat permeability. This genotype, which was the most resistant to incubator weathering, had the lowest seed coat permeability. While the other small-seeded genotype such as Betet, which was susceptible to incubator weathering had the highest seed coat permeability. This result indicated that resistance to incubator weathering for mung beans was related more to seed coat permeability than seed size. The similar result was also reported by Dassou and Kueneman (1984) for soybean. According to Kuo (1989), seeds with low seed coat permeability might gain their protection against seed deterioration during incubator weathering from a seed coat which tends to imbibe water at slower rate than those with high seed coat permeability.

The results obtained from this study showed that a high negative correlation (r = - 0.75 P<0.05) was observed between seed coat lignin content and seed coat permeability (Table 3). This indicated that mung bean seeds with high lignin content tended to have low permeability. The positive effects of lignin on protecting mung bean seeds against incubator weathering was understood since lignin in the seed coat has impermeabilization characteristics and exerts an important effect on the capacity and velocity of absorption of water throughout the seed coat (McDougall et al., 1997). The proposed reasons were in agreement with Kuo (1989), who reported that soybean seeds with low seed coat permeability tended to imbibe water at slower rate. Thus, the involvement of lignin in resistant mechanism of mung bean seeds to incubator weathering was through controlling seed coat permeability.

Experiment II. Evaluation of mung bean fenotypes for resistance to storage deterioration

Among the genotypes subjected to 8 month storage period, three genotypes, Bhakti, Gelatik and Parkit, consistently maintained high seed viability and seed vigor (>80%) (Table 4) and might be classified as a good “storer”. Among these three genotypes, Bhakti was identified as being the most resistant to adverse storage conditions as indicated by the highest score of germination and accelerated aging germination, and the lowest value of electrolyte conductivity followed by Gelatik and Parkit respectively (Table 4). Similar superior resistance was also exhibited by seed of Bhakti when it was exposed to unfavorable conditions during incubator aging. Meanwhile, viability and vigor of seeds of Betet, Kenari, Merak, IPB.M/97-13-60, VC-3012-B and Vr.1686-3-8-B had decreased to below 80%, which might be classed as a poor “storer”. For breeding purposes, however, further studies are needed to determine the heritability of seed storability. If the studies indicate a high level of probability, a resistant genotype such as Bhakti can be exploited as sources of genes for better seed storability.

The superior resistance to adverse storage conditions for Bhakti, Gelatik and Parkit was attributed to its slower rate of moisture reabsorption during storage as reflected by its relatively low seed moisture content. Their seed moisture content at 8 month storage period was 12.1% for Bhakti, 12.6% for Gelatik and 12.8% for Parkit. While the other genotypes had a seed moisture of 13.8% for Kenari, 14.0% for Merak, 14.1% for Vr.1686-3-8-B, 14.6% for IPB.M/97-13-60, 14.8% for VC-3012-B and 14.5% for Betet, respectively. The slower rate of moisture reabsorption during storage exhibited by these three genotypes was probably a result of lower seed coat permeability as shown by a highly positive correlation ($r = 0.93$ $P<0.01$) between seed moisture and seed coat permeability. These three genotypes with less permeable seed coat experienced less exposure to moisture reabsorption during storage and tended to absorb moisture at a slower rate than the other genotypes with more permeable seed coat and this would protect them from deterioration due to adverse conditions during storage. As a result of this decreased response, genotypes with less permeable seed coat could be expected to have lower levels of moisture at the end of storage period and higher level of seed viability and vigor than those with more permeable seed coat. The proposed reasons were in agreement with Marwanto (2003b) and Kuo (1989) who worked with soybeans. They reported that soybean seeds with low seed coat permeability tended to imbibe moisture at slower rate than others and this ‘delayed imbiber’ might resist absorption of moisture during storage and then protect seed from deterioration. Kuo (1989) further stated that the respiration rate of seed was accelerated with increased seed moisture content and this respiration interferes with the seed quality of rapid-imbibed seeds to greater extent than slow-imbibed seeds.

The superior resistance to ambient storage for the three genotypes, Bhakti, Gelatik and Parkit was probably related to lignin content in their seed coat as well. Correlation analysis showed that lignin content in the seed coat was correlated with seed germination ($r=0.86$ $P<0.01$), with accelerated aging germination ($r=0.53$ $P<0.05$), and with electrolyte conductivity ($r=-0.96$ $P<0.001$) (Table 5). These strong correlations suggested that lignin content in the seed coat might be involved in reducing the rate of seed deterioration due adverse storage conditions, thus establishing positive influence of lignin content on maintaining seed viability and vigor during storage. Another researcher working with soybeans (Marwanto *et* *al.*, 2003) also found a strong correlation between resistance to adverse storage conditions and lignin content in the seed coat.

The positive effects of lignin on protecting mung bean seeds against adverse storage conditions was understood since lignin in the seed coat has impermeabilization characteristics and exerts an important effect on the capacity and velocity of absorption of moisture throughout the seed coat (McDougall et al., 1997). The result of this experiment showed that lignin content in the seed coat was correlated ($r = -0.75$ $P<0.05$) with seed coat permeability (Table 5). This table showed that genotypes with high lignin content in the seed coat tended to have low seed coat permeability, or vice versa. This result was in agreement with Marwanto (2003b) and McDougall et al. (1997) who worked with soybeans. Thus, the involvement of lignin in resistant mechanism of mung bean seeds to ambient storage was through controlling seed coat permeability.

The result showed that positive correlations were observed between seed quality indicators after incubator weathering and after ambient storage. The coefficient correlation between seed germination following incubator weathering and seed germination following 8 months of ambient storage was 0.85 ($P<0.05$) and between elctrolyte conductivity following incubator aging and electrolyte conductivity following 8 months of ambient storage was 0.73 ($P<0.05$). This indicated that most genotypes resistant to incubator aging were also resistant to deterioration in storage or vice versa. The similar result was also reported by Dassou and Kueneman (1984) and Marwanto (2004) for soybeans.

CONCLUSIONS

Mung bean genotypes differed in their resistance to both field and storage deterioration. Seed coat permeability, which was inversely related to seed coat lignin content, attributed to this difference. The genotypes resistant to field deterioration were also resistant to storage deterioration or vice versa.

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