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Field Performance of Mungbean (*Vigna radiata* Wilczek) Seed differing in Vigour Levels.

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RINGKASAN

Satu kajian telah dijalankan di Universiti Pertanian Malaysia, Serdang, Selangor, untuk menyelidik pengaruh kecergasan bijibenih ke atas performa di ladang bagi Vigna radiata. *Bijibenih kultivar U-Thong yang mempunyai kecergasan sederhana dan rendah telah di perolehi dengan mendedahkan bijibenih berkualiti tinggi kepada suasana suhu dan kelembapan udara yang tinggi. Percambahan bijibenih mempunyai pertalian terus dengan peringkat kecergasan, di mana perbezaan-perbezaannya adalah bererti. Beberapa sifat komponen keluaran didapati telah di pengaruhi dengan berertinya oleh kecergasan bijibenih. Pokok-pokok yang dihasilkan daripada bijibenih dengan kecergasan tinggi mengeluarkan hasil yang lebih tinggi (1300 kg/ha) daripada pokok-pokok yang dihasilkan daripada bijibenih dengan kecergasan sederhana (884 kg/ha) dan kecergasan rendah (767 kg/ha). Walau bagaimanapun, beberapa sifat tampang didapati tidak dipengaruhi oleh kecergasan bijibenih.*

SUMMARY

A study was conducted at Universiti Pertanian Malaysia, Serdang, Selangor, to investigate the influence of seed vigour on field performance of Vigna radiata. *Seeds of the U-Thong cultivar of medium and low vigour were obtained by subjecting high quality seeds to an atmosphere of high temperature and high relative humidity. Germinability of seeds corresponded directly with their respective vigour levels, with the differences being significant. Some yield component characteristics were found to be significantly influenced by seed vigour. Plants established from high vigour seeds produced significantly higher seed yield (1300 kg/ha) than those from medium (884 kg/ha) and low vigour seeds (767 kg/ha). However, some vegetative characteristics did not appear to be influenced by seed vigour.*

INTRODUCTION

"Seed vigour" is frequently used as a measure of seed quality by agronomists, seed analysts and related scientists, as well as by some progressive farmers. For practical purposes, Delouche and Caldwell (1960) defined seed vigour as "the sum of all seed attributes which favour rapid and uniform stand establishment in the field". Until fairly recently, it was generally assumed that the influence of seed vigour on performance did not extend beyond emergence. But now, it seems quite clear that the vigour of seed can and does influence the growth, development and productivity of the plants produced.

LITERATURE REVIEW

Sowing low quality seeds can be a major cause of stand failures. These evidently are costly consequences to farmers because they have to bear the cost of additional seeds to be resown and at the same time have to spend a lot of precious time on the job.

Early studies on the effects of seed deterioration and vigour on performance potential were focussed on stand establishment (Raspet, 1963; Delouche, 1973). More recently, however, such studies have been extended to encompass the effects of seed quality on plant growth, development and productivity. Seed vigour had been

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demonstrated to have substantial influence on plant growth (Gill, 1969; Assuncao, 1972). Grabe (1967) pointed out that low vigour seeds yielded poor stands despite the high laboratory germination. Edje and Burris (1971) observed that the lowest vigour seeds emerged slowest. Baskin (1970) observed that peanuts produced from high quality seeds produced the highest stand and yield. Perry (1969) working with pea seeds of high and low vigour and planted at similar plant population, found that plants of low vigour seeds had a lower yield potential than those of high vigour seeds. Munn (1946) attributed low yields of kidney beans to the low vigour of seed planted.

MATERIALS AND METHODS

Laboratory Experiments

a) Accelerated ageing

High quality seeds of the U-Thong mungbean cultivar were subjected to an accelerated ageing treatment using an apparatus as illustrated in Figure 1. The apparatus was a modification to the one described by Delouche and Baskin (1973). Seeds were removed from the ageing chamber at the end of 48 and 96 hours. After a 48 hour equilibration period at room temperature, the germinability of seeds was determined by the standard germination test. Resultant sublots after ageing treatment were designated as A, B and C corresponding to 0, 48 and 96 hours of ageing, respectively.

b) Standard germination test

Four hundred seeds (50 seeds × 8 replicates) from each of sublots A, B and C were used in the standard germination test, using moist, fine river sand as the growing medium. Each seedling was evaluated in accordance with the criteria prescribed in the International Rules for Seed Testing (I.S.T.A. Rules, 1976).

c) Tetrazolium (TZ) test

Four hundred seeds (50 seeds × 8 replicates) each sublot were allowed to absorb moisture from moistened filter paper for 16 hours. The moistened seeds were then immersed completely in 0.20% aqueous solution of 2, 3, 5-triphenyl-tetrazolium chloride (TTC) at 35°C for 2-3 hours to affect staining. Then, the TTC solution was decanted and the seeds rinsed with running water before evaluation. The stained seeds were evaluated in accordance with the guidelines provided by Grabe (1970) in the "Tetrazolium Testing Handbook". Seeds remained immersed in water until evaluation was completed.

Field Experiment

The seeds of sublots A, B and C were planted on 23rd September 1978 in a randomised

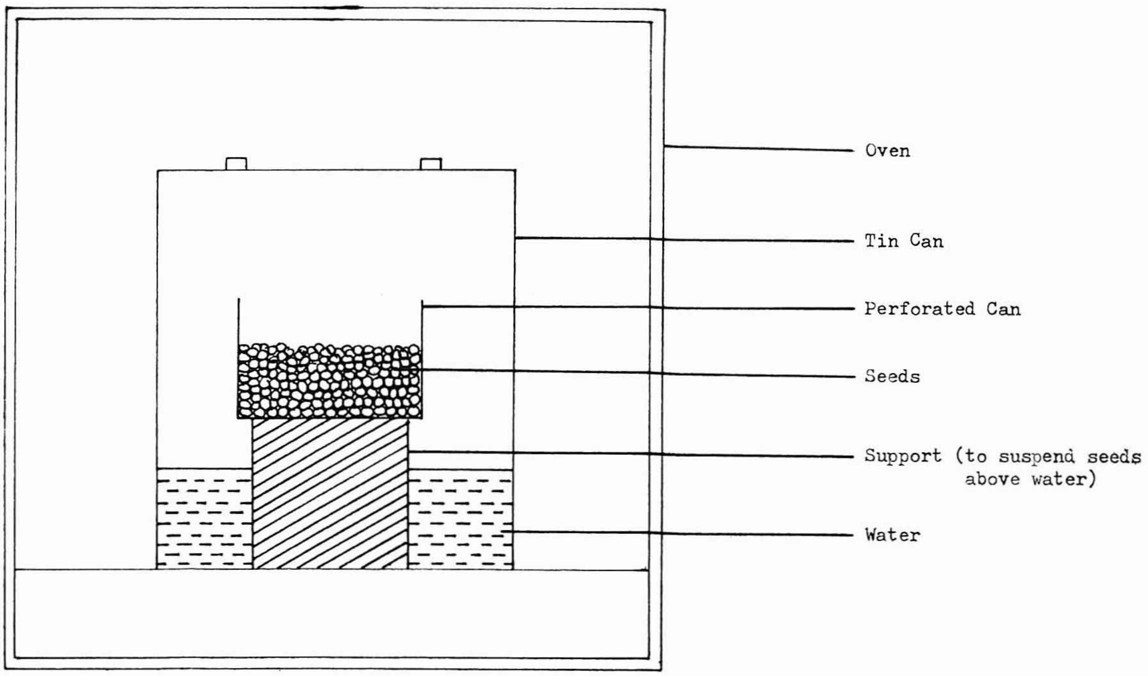

Figure 1. The apparatus used to age the high vigour seeds

complete block design (RCBD) with three replicates at the Universiti Pertanian Malaysia Agronomy Research Area using a planting distance of 50 cm by 30 cm. The seeding rates used were 8.00 kg/ha, 12.00 kg/ha and 16.00 kg/ha corresponding to sublots A, B and C, respectively. Fertilizers were added at the rate of 148 kg/ha N, 98 kg/ha P_2O_5 and 198 kg/ha K_2O. Thinning of seedlings, leaving only one seedling per planting point, was done one week after planting.

RESULTS AND DISCUSSION

Laboratory Experiment

Effects of accelerated ageing on seed germination.

Subjecting mungbean seeds to high temperature (50°C) and high relative humidity (90%) resulted in a significant loss in germination capacity. Table 1 shows that seed germination declined from an initial 96% to 77% and to 63% after accelerated ageing treatments of 0, 48 and 96 hours, respectively. There was a significant increase in percent dead seed with decreased seed vigour.

Topographic TZ evaluations revealed that seeds of reduced vigour possessed reduced germination potential (Table 2).

The decline in germination capacity and increase in abnormal seedlings and dead seeds of the aged seeds could be attributed to the effect of accelerated ageing. Among other things, accelerated ageing could cause cytological deterioration such as degradation of cellular membranes and subsequent loss of control of permeability. This was further illustrated by the deep TZ stain, suggesting easier penetration through cellular membranes by the TZ solution. The loss of membrane integrity led to the reduced efficiency of sub-cellular organelles such as mitochondria and ribosomes, and enzymes.

Field Experiment

The effect of seed vigour on growth and development.

Table 3 shows the average plant height measured weekly. Results indicated that the trend of increase in height was similar for all plants regardless of the vigour levels of the seeds planted. Similarly, the number of branches per plant was not significantly affected by seed vigour. On the average, plants derived from high, medium and low vigour seeds produced 3.88, 4.03 and 3.77 branches per plant, respectively. All plants attained 50% flowering 40–41 days after planting regardless of seed vigour levels.

TABLE 1
Germination of mungbean seeds after 0, 48 and 96 hours of ageing at 50°C and 90% relative humidity

Hours of ageing at 50°C, 90% R.H.	Sublot	Designated vigour level	% Total germination	% Abnormal seedling	% Dead seed
0	A	High	96Aa*	0Ba	4Ca
48	B	Medium	77Ab	1Bb	22Cb
96	C	Low	63Ac	1Bb	36Cc

* Similar capital letters in row and small letters in column denote no significance at 5% level (DNMRT).

TABLE 2
Germination potential of mungbean seeds of different vigour levels as revealed by the tetrazolium test

Seed vigour	Tetrazolium Class*				
	Germinable		Potential Germination	Non-germinable	
	I	II	%	III	IV
High	93Aa**	3Ba	96	3Ba	1Ba
Medium	74Ab	6Ba	80	9BCb	11Cb
Low	58Ac	8Ba	64	4BCa	30Cc

* Class I – all seed tissues stained – germinable.
II – tissues essential for germination stained – germinable.
III – tissues essential for germination not stained or only partially stained – non-germinable.
IV – most seed tissues not stained – non-germinable.
** Similar capital letters in row and small letters in column denote no significance at 5% level (DNMRT).

TABLE 3
Mean plant height measured weekly

Seed vigour	Plant height (cm)										
	Weeks after planting										
	2	3	4	5	6	7	8	9	10	11	12
High	8.41a*	11.61a	17.07	32.84a	46.67a	51.67a	53.16a	54.19a	54.48a	54.50a	54.50a
Medium	8.93a	11.99a	17.58a	33.24a	47.90a	52.45a	53.28a	53.95a	54.16a	54.19a	54.19a
Low	8.47a	11.86a	18.21a	34.20a	48.31a	54.22a	55.31a	55.66a	55.75a	55.76a	55.76a

* Similar letters in row and column denote no significance at 5% level (DNMRT)

TABLE 4
Mean values of yield parameters taken on mungbean plants derived from high, medium and low vigour seeds

Seed vigour	Parameter				
	Branches/plant	Pods/plant	Seeds/pod	100-seed Weight (grams)	Seed yield** (metric ton ha^{-1})
High	3.88a*	30.87a	10.34a	6.96a	1.30a
Medium	4.03a	23.64b	9.40a	6.37b	0.88b
Low	3.77a	20.75c	8.91a	6.40b	0.77b

* Similar letters in the column of a particular parameter denote no significance at 5% level (DNMRT)

** Values obtained by calculation

The effect of seed vigour on yield components.

Table 4 shows that seed vigour had a profound influence on yield components. There was a decrease in the number of pods per plant and seeds per pod with decreasing seed vigour. This could be due to reduced photosynthetic and translocating efficiency of plants derived from low vigour seeds. Plants derived from high vigour seeds produced significantly heavier seeds than those from the medium and low vigour seeds. The final seed yield of plants derived from high vigour seed was highest (1300 kg/ha) and the lowest being that from the low seed vigour plants (767 kg/ha). The medium seed vigour plants produced an intermediate seed yield of 884 kg/ha. Statistically, their differences were found to be significant.

Results of the experiment substantiated earlier reports that the vigour of seeds sown would have an influence on the productivity of plants produced from them. Faster emergence, more vigorous plants and more efficient metabolism (such as photosynthesis and translocation of food materials) could be some of the factors contributed by high vigour seeds. Low vigour seeds, on the contrary, would result in slower emergence, weaker and less metabolically efficient plants. However, some vegetative traits (such as plant height and number of branches per plant) studied were not significantly affected by initial seed vigour. Such an observation can be attributed to the fact that, given enough time, less vigorous plants could "catch-up" in terms of production of vegetative parts. Nonetheless, those parts that "caught-up" were not able to equal the vigorous plants in terms of productivity potential. Thus, plants derived from low vigour seeds produced lower seed yield than those plants derived from high vigour seeds.

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