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# Comparative Efficacy of Different Vigour Test Parameters of Pea (*Pisum sativum* L.) Seed Testing

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**Abstract:** The objective of the present study was to determine the compatible laboratory vigour test parameters of pea with respect to field emergence value. The experimental material constituted a germplasm collection of 4 lines of pea viz., P3, P6, PSM and Arkel. Different vigour test methods were applied to achieve the objective of this investigation. The results of different vigour tests values reflected information that different vigour assessment methods give varied results. It may be concluded that the seedling dry weight a performance test in optimum condition was found most efficient, quick and compatible in comparison to others. Besides seedling dry weight test, brick gravel test, a stress test may also be useful to predict field emergence of pea seed under suboptimal conditions as their values were close consistent to field emergence index next to dry weight.

**Key words:** Pea % Efficient method % Vigour test % Field emergence % Suboptimal condition

## INTRODUCTION

Since seed vigour is highly complex, tests have focused on measuring one or more of the parameters involved in seed deterioration. The problem in predicting field germination is that it is impossible to predict the weather with the necessary precision. Vigour testing is one possible solution. The vigour test does not predict performance for a particular set of fluctuations; rather, it predicts the general ability of a seed lot to germinate normally over a range of adverse conditions. Additional tests are needed to better predict seedling emergence under a wide range of field conditions.

The relationships between the vigour assessments and field emergence of individual cultivars were not always significant. Although vigour tests can identify low vigour seed lots of combining pea, may be difficult to routinely apply a single seed vigour test to seed lots from all cultivars [9]. The dry weight assessments excluding the cotyledons, were closely related to vigour [3]. The prolongation of ageing led to deterioration of both germinability and seed viability [10]. The laboratory germination test failed to indicate vigour differences within the combined data of all cultivars but, in contrast, the mean germination time gave the clearest identification of vigour differences [9]. The accelerated aging test was efficient for vigour evaluation of pea seeds. It was possible to identify the best seed lots [8]. The electrical conductivity test was not a good indicator for the degree of seed deterioration stored at low temperatures [7]. The conductivity test may be useful to predict field performance of pea seed lots under suboptimal conditions [5].

In view of the problems and prospects, the present work was undertaken with an objective to determine the quick and compatible laboratory vigour test parameter of pea with respect to field emergence.

## MATERIALS AND METHODS

The material constituted a germplasm collection of 4 lines of pea (*Pisum sativum* L.) viz., P3, P6, PSM and Arkel, collected from Pantnagar. The methods comprised of the followings:

### Stress Test

**Accelerated Aging (AA):** 25 seeds per tray in a plastic box containing 40ml of water and with lid were placed. The aging chamber was placed in an incubator. The seed samples were aged at a temperature of 42°C in a high humidity (˜100% RH) chamber for 72 hours.

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**Brick Gravel (BG):** 25 seeds per replicate were obtained and about 3 cm layer of moist gravel (2 to 3 mm size) was placed above the seed. The inter-wedging of the brick gravel places a stress upon the emergence of elongating shoots. The seedlings that emerge through the layer of brick gravel were considered vigorous.

**Biochemical Test**

**Electrical Conductivity (EC):** 25 seeds were weighed and surface sterilized. Then seeds were immersed in 100 ml of deionized water at 25°C for 24 hrs. The conductance of distilled water was measured in a beaker. The electrode was then cleaned with a tissue paper and conductance of the leachate was read. Lower the value of EC greater will be the seed vigour. It was calculated as follows and unit expressed as micro Siemens per centimeter per gram (µs/cm/g) of seed;

$$\text{Conductivity (µs/cm/g)} = \frac{\text{Solution Conductivity - Control Conductivity}}{\text{Weight of replicate (g)}}$$

**Performance Test in Optimum Condition**

**First Count (FC):** The number of normal seedlings, germinated on the first count day was counted. Higher the number of normal seedlings greater will be the seed vigour. This test was done by using towel paper.

**Germination Index and Speed of Germination (GI and SG):** Number of seedlings emerging daily was counted from day of planting till the time germination was complete. Thereafter GI and SG was computed by using the following formulae:

$$G.I. = \sum n/d$$

Where:

n = Number of seedlings emerging on day 'd';

d = Day after planting

Number of germinated seeds was counted every day from the first day and the cumulative index was made to compute the speed of germination by using the formula:

$$\text{Speed of germination} = N1/1 + n2/2 + \ldots\ldots + nx/x = N$$

Where:

N1 = Nx are the no. of seed germinated on day 1 to day x;

1 = X are the no. of days

**Seedling Growth Rate (GR):** Observation was taken on 5 competitive normal seedlings. For the next 5 days the length of each seedling was measured daily in cm. Seedling growth rate was determined as described by Copeland [2].

$$SL1/F1 + (SL1 - SL2)/F2 + \ldots\ldots + [SLn - SL(n-1)] / Fn$$

Where:

SL1 - Mean seedling length at first count;

SL2 - Mean seedling length at second count;

SL1 - SL2-mean increase in length in second count;

F1 - Days to first count; Fn-days to final count

**Seedling Length and Dry Weight (SL and DW):** SL was taken from the soil surface after 11 days from the date of sowing in randomly selected five seedlings from each replication. The dry weight of the 5 randomly selected seedlings (without cotyledons) for each replicate was measured after it was dried on oven at 100°C for 24 hrs.

**Field Emergence Test (FE):** It represents the actual seedling vigour percent of a variety or seed lot as it exposed to the natural unfavorable environment. 50 seeds to each replicate and 4 replication for each variety were sown.

## RESULTS AND DISCUSSION

Low vigour seeds are unlikely to survive adverse conditions and may fail to produce vigorous seedlings. Seedling vigour classifications describe normal and abnormal seedlings which help in the classification of strong and weak categories, provides a means of further seed quality analysis. Safe seed moisture is essential for safe seed storage and accurate quality determination of seed.

Accelerated aging can determine the seed storability of a seed lot. The results of accelerated aging were found negative relationship showing it will be more suitable to predict the seed storability (Table 1). When aged of the seeds the viability of the seeds lost by some percent. An ageing temperature was found most considerable irrespective of ageing time as it led more deterioration than time factor [8, 6], but prolongation of time too long of ageing may leads to deterioration of both germinability and seed viability, these had been discussed by Hampton *et al.* [4] and Veselova and Veselovsky [10].

Table 1: Analysis of relationships between field emergence with other vigour test parameters. [r = correlation, 1st c = First count, Fc = Final count]

| | Field emergence (%) | | | Accelerated aging (%) | | Brick gravel (%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ---------- | | Moisture | ---------- | | ---------- | | Cunductivity | | | | | Seedling length | Dry weight |
| Variety | 1st c | Fc | (%) | 1st c | Fc | 1st c | Fc | (µs/cm/g) | 1st count (%) | Germination index | Speed germination | Growth rate | (cm) | (mg) |
| P-3 | 48.0 | 86.0 | 11.60 | 12.000 | 44.000 | 32.000 | 48.00 | 0.113 | 80.00 | 77.00 | 3.400 | 0.5800 | 6.5000 | 91.0 |
| P-6 | 26.0 | 74.0 | 11.70 | 20.000 | 88.000 | 32.000 | 40.00 | 0.048 | 40.00 | 72.00 | 2.850 | 0.6200 | 5.5000 | 82.0 |
| PSM | 36.0 | 70.0 | 10.90 | 16.000 | 76.000 | 16.000 | 28.00 | 0.097 | 40.00 | 72.00 | 2.790 | 0.5300 | 6.7000 | 80.0 |
| Arkel | 30.0 | 84.0 | 10.80 | 20.000 | 56.000 | 44.000 | 52.00 | 0.074 | 80.00 | 77.00 | 2.640 | 0.6800 | 5.9000 | 90.0 |
| SEm± | 4.80 | 3.86 | 0.230 | 1.9100 | 9.8700 | 5.7400 | 5.290 | 0.010 | 11.55 | 10.00 | 0.170 | 0.0300 | 0.2800 | 1.00 |
| r with 1st c | | | 0.179 | -0.980* | -0.747 | -0.230 | 0.105 | 0.941 | 0.482 | 0.482 | 0.852 | -0.498 | 0.7700 | 0.109 |
| r with Fc | | | 0.102 | -0.293 | -0.884 | 0.7590 | 0.930 | 0.330 | 0.972* | 0.972* | 0.452 | 0.5410 | -0.039 | 0.997* |

*significant at 5% level

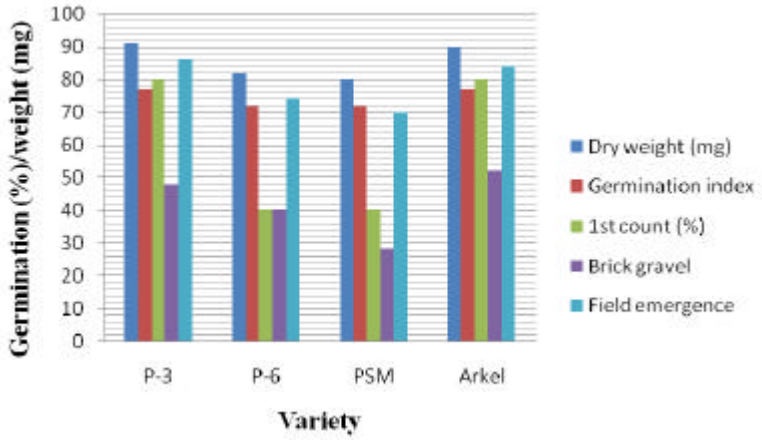


Fig. 1: Assessment of reliable vigour test for pea seed testing

(A) (B)

Plate 1: Brick Gravel test (A) vigour seedlings emerged by overcoming the impedance (B) germinated but unable to emerge due to hindrances (low vigour seeds).

Seeds were germinated almost uniformly in all the replicates of respective varieties but in this test only the seedlings that can emerge through the layer of brick gravel were recorded. Brick gravel test was found positive relationship with field emergence although non significant in magnitude, which revealed reliable to some extent for pea vigour parameter. The relationship with conductivity was found non significant. Our results confirms the findings obtained by Powell and Matthews and Maristela Panobianco *et al*. [7], but it contradicts with the findings reported by Ladonne [5].

In every standard vigour test by germination methods the first count number is very essential it indicates the real percent of vigour seeds of a seed lot.

The highest germination percent at the first reading means the seed lot is vigour as the seedlings come out by overcoming the impeding forces at the earliest time. First count parameter was observed significant positive relationship with field emergence, similar relationship was also found in germination index method. The germination speed and seedling growth rate revealed non significant relationship. The number of seedlings emerging daily gives information of range of vigour of the seed lot. Mean seedling length and dry weight were also of the basic methods of measuring seedling growth rate. Seedling length was observed non significant negative relationship with field emergence whereas dry weight assessment revealed the highest significant positive relationship showing the most compatible vigour test to assess the field emergence of pea seed. Similar result was also reported by Edje and Burris [3] on soybean.

Seedling growth rate test enables to measure the physiological characteristics of the seed. The recorded values of seedling growth rate were slightly comparable with other tests values but cannot be used as a laboratory test to predict the field emergence as the values were not positive relationship.

The different vigour tests values reflect information that different vigour assessment methods gave varied results and their relationship was found non significant. From the above discussion it may be concluded that the “seedling dry weight” which revealed highest correlation value was found most efficient, quick and compatible in comparison to others.

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