Identification of Twenty-One *Brassica* Genotypes through Physiological Parameters

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Abstract: ***Average germination potential of harvest fresh seeds was recorded to be maximum i.e., 98 % for Agrani, Saroma, SP-2, SP-5 and SP-6 irrespective of the years of experimentation; in addition to those exactly similar performance (98% germination) was noted for Multi Locular only in 2012-13, and for Benoy, Rajendra Sarson, Samrat and SP-1 in 2013-14. Speed of germination of seed was also exhibited as maximum by Saroma in both the years followed by similarly performing Rajendra Sarson and Panchali produced in 2013-14, while Saroma was followed by Panchali, SP-6, Sanjukta and Rajendra Sarson, in 2012-13 having non-significant differences amongst itselves. Seeds of SP-1, SP-3 and SP-5 also exhibited higher speed of germination in both the years. Variation in both seedling fresh and dry weight was found to be significant amongst the genotypes considered under this programme. Maximum magnitude of vigour index was determined for the genotype Rajendra Sarson in both the years being significantly best performer than the other genotypes except Samrat in 2013-14 only. It was followed by Tori Local, Sanjukta and Samrat in first year and by Jumka, Tori Local, Sanjukta and NRCYS in second year, the laters performed significantly in similar manner in both the year. While the seeds of Multi Locular were of lower vigour status preceded by SP-7 in both the years, though non-significant difference in this parameters was noticed between these two genotypes in 2013-14.***

Keywords: *Brassica* genotypes, germination, vigour index, physiological identification

1. Introduction

India is one among the leading oil seed producing countries in the world. Oilseeds form the second largest agricultural commodity after cereals. *Brassica* oilseeds are important source of edible oil in many countries of the world, including India and China, the two big developing countries which are being confronted with increasing population and corresponding demand for agricultural products, limited by the decline of arable land. Rapeseed and Mustard occupies an area of 6.3 m ha with production of 7.4 million tonnes and productivity of 1176 kg per ha in India (Economic Survey, 2012-13) [1]. The estimated area, production and yield of rapeseed-mustard in the world was 34.19 million hectares (m ha), 63.09 million tonnes (m t) and 1,850 kg/ha, respectively, during 2012-13. Proper explicit knowledge of seed development is the pre-requisite for formulation of a successful seed production and crop improvement programme, which may provide a broad description about the mode of changes during seed development at various stages from flowering to maturity in different varieties. Observations regarding details of morphological, physiological and biochemical changes will help in understanding the pattern of changes in developing seeds at various stages. The identification of distinct morphological and physiological characteristics of these three phases is an important step in understanding the mechanism of seed development.

2. Material and Methods

The present investigation was conducted from 2012 to 2014 at District Seed Farm 'D' Block, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal. Harvest fresh seeds produced through field experiment were cleaned and dried properly to 6-7% moisture content and then placed for germination through both petri-plate and glass-plate method. Both speed of germination, germination potential were determined from the laboratory experiment set on petri-plates method and seedling parameters *viz*., total seedling length, seedling fresh weight and vigour index (on the basis of both total seedling length and seedling dry weight) were determined through the laboratory experiment set on glass-plate method.

1. Speed of germination
Speed of germination was determined following the formula suggested by Maguire (1962) [2].
Speed of germination = 2(n/t)
Where, n = number of seeds germinated at time't', and t = days from sowing.

2. Germination percentage
The germination test was done in petri-plates for all the twenty-one genotypes. 100 seeds were placed in each petri-plate for one replication and each treatment was replicated thrice. Inside the petri-plates, cotton and blotting paper were kept, and moistened adequately avoiding excessive water. The petri-plates with the seeds germinated was counted in every single day till the final count on 7th day on the basis of normal seedlings produced. Germination (%) was calculated as:

$$\frac{\text{Number of seeds germinated producing normal seedlings} \times 100}{\text{Total number of seeds used}}$$

3. Shoot length (cm)
On completion of germination on 7th day, shoot length was measured on individual seedlings from collar region to apex of the apical shoot for the randomly selected ten normal

seedlings on the day of final count of germination test and their mean length was recorded as shoot length in centimetres.

4. Root length (cm)
Root length was measured on single seedling basis between collar region to tip of the primary root for the same ten randomly chosen normal seedlings used for shoot length measurement. The mean root length was expressed in centimetres.

5. Seedling length (cm)
Seedling length was calculated by adding shoot length and root length as measured for each randomly chosen ten normal seedlings. Their mean length was expressed as seedling length in centimetres.

6. Seedling fresh and dry weight
The ten normal seedlings used for measurement of root and shoot length were used for recording seedling dry weight and were kept in hot air oven for drying at 70^0C for 24 hours. Dried seedlings were cooled in desiccator for 30 minutes and their weight was recorded. Their average was calculated and expressed in grams per seedling.

7. Vigour index
For determination of vigour index, average seedling lengths i.e., total of root and shoot length was multiplied by average germination percentage (Abdul-Baki and Anderson, 1973) [3] for each genotype and replication.
Seedling vigour index (SVI) =
Germination percentage X seedling length (cm)

3. Result and Discussion

Seeds of collected genotypes in both the years were harvested at field maturity, dried with care to 6-7 moisture content and then placed for germination at 25±1˚C in glass plates as well as in petri dishes. Germination (%), seedling length (cm), fresh and dry seedling weight (g), and vigour index were determined on the basis of days to final count i.e., 7 days after placing for germination. Speed of germination was also recorded for all the genotypes studied. Germination (%) and speed of germination were recorded from the petri dishes of individual genotypes, while recording on other parameters were made from glass plates.

Average germination potential of harvest fresh seeds was recorded to be maximum i.e., 98 % for Agrani, Saroma, SP-2, SP-5 and SP-6 irrespective of the years of experimentation; in addition to those exactly similar performance (98% germination) was noted for Multi Locular only in 2012-13, and for Benoy, Rajendra Sarson, Samrat and SP-1 in 2013-14. Significant variation among the genotypes for all these parameters was clearly evident from Tables 1.1 and 1.2. Significantly similar and lowest magnitude of germination was recorded for SP-7, PT-303 and Sanjukta in 2013-14, while the same could be recorded by SP-7 and PT-303 preceded by Sanjukta in 2012-13. Variation in magnitude among the genotypes for this parameter during years of seed production may be due to variation in characteristic response of individual genotypes towards higher humidity as well as the rainfall during maturation of seeds in second year. The findings of the present study were in concurrence with earlier findings of Renganayaki and Krishnasamy (2001) [4].

Speed of germination of seed was also exhibited as maximum by Saroma in both the years followed by similarly performing Rajendra Sarson and Panchali produced in 2013-14, while Saroma was followed by Panchali, SP-6, Sanjukta and Rajendra Sarson, in 2012-13 having non-significant differences amongst itselves. It was of minimum value for Tori Local preceded by SP-7 and Jhumka in both the years, though the later two performed in statistically significant manner. Seeds of SP-1, SP-3 and SP-5 also exhibited higher speed of germination in both the years.

Significant variation among the genotypes for average seedling length could also be utilized for its identification. It was as long as 21.30 cm and 20.98 cm for Sanjukta in respective years, its range varied between 11.99 cm for Multi Locular to 21.30 for Sanjukta in 2012-13 and between 12.66 to 20.98 cm for the same genotypes in second year (Muthoni, 2010) [5]. Variation in magnitude for this parameter could also be noticed over the years: it was of higher magnitude in first year for some genotypes, while those positions were occupied by the other genotypes in second year; this variation in performance over the years may be due to production of varying quality of seeds in response to its genotypic preference towards sudden adverse climatic condition during advancement in maturity.

Variation in both seedling fresh and dry weight was found to be significant amongst the genotypes considered under this programme; therefore, identification of these genotypes can also be made through these parameters. Rajendra Sarson can be identified as the genotype producing seedlings with maximum fresh and dry weight, significantly higher than those of any genotype under consideration. It was followed by Jhumka, White Flower, NRCYS, Mullti Locular and Saroma in both the years for average seedling fresh weight. While for seedling dry weight, Rajendra Sarson was followed by Jhumka, White flower, Multi Locular and NRCYS irrespective of the years of experimentation. However, the magnitude of seedling fresh weight ranged between 0.121 and 0.207g in 2012-13, and 0.112 and 0.205 g in 2013-14: while seedling dry weight varied between 0.017 and 0.034 g, and 0.016 and 0.033 g in respective years. Consideration of performance for these two parameters led to grouping of the genotypes exhibiting similar performance in different fashion which may be utilized while identification of these genotypes is made Bhajan *et al*. (2013) [6].

Vigour index of the seedlings have been considered here as a joint function of germination (%) and seedling length. It is, therefore, estimated as the derived seed quality parameter through the combinations as reflected in expression of vigour indices of individual genotypes. Maximum magnitude of vigour index was determined for the genotype Rajendra Sarson in both the years being significantly best performer than the other genotypes except Samrat in 2013-14 only. It was followed by Tori Local, Sanjukta and Samrat in first

year and by Jumka, Tori Local, Sanjukta and NRCYS in second year, the laters performed significantly in similar manner in both the year. While the seeds of Multi Locular were of lower vigour status preceded by SP-7 in both the years, though non-significant difference in this parameters was noticed between these two genotypes in 2013-14. Similar to germination percent, magnitude of this parameter was reduced in 2012-13 for most of the genotypes with few exceptions which may be due to the greater influence of germination (%) while determining vigour index. Similar results have been earlier reported by Yadav *et al*. (2013) [7].

4. Conclusion

Variation in all the characters was found to be significant amongst the genotypes considered under this programme; therefore, identification of these genotypes can also be made through these parameters. Variation in magnitude among the genotypes for this parameter during years of seed production may be due to variation in characteristic response of individual genotypes towards higher humidity as well as the rainfall during maturation of seeds in the second year. Maximum magnitude of vigour index was determined for the genotype Rajendra Sarson in both the years being significantly best performer than the other genotypes except Samrat in 2013-14 only. Variation in both seedling fresh and dry weight was found to be significant amongst the genotypes considered under this programme, thus, consideration of performance for these two parameters led to grouping of the genotypes exhibiting similar performance in different fashion which may be utilized while identification of these genotypes is made.

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Table 1.1: Identification of genotypes through physiological parameters (2012-13)

***Figures in parentheses are Square root transformed values**

Genotypes	Germination (%)	Speed of germination	Seedling length (cm)	Fresh seedling weight (g)	Dry seedling weight (g)	Vigour index
AGRANI	98 (9.92)	17.56	15.83	0.124	0.017	1544.48
BENOY	96 (9.82)	17.02	16.42	0.142	0.024	1635.62
JHUMKA	96 (9.82)	15.47	18.55	0.187	0.030	1809.60
MULTI LOCULAR	98 (9.92)	18.03	11.99	0.151	0.028	1215.36
NRCYS	90 (9.51)	17.68	19.76	0.165	0.027	1759.04
PANCHALI	90 (9.51)	20.35	17.02	0.121	0.017	1485.90
PT 303	82 (9.08)	18.42	16.89	0.124	0.018	1400.56
RW 351	92 (9.62)	18.56	17.44	0.123	0.018	1624.32
RAJENDRA SARSON	96 (9.82)	20.08	20.46	0.207	0.034	1885.52
SAMRAT	96 (9.82)	18.75	18.87	0.125	0.019	1828.68
SANJUKTA	86 (9.30)	20.09	21.30	0.126	0.021	1762.32
SAROMA	98 (9.92)	22.00	17.56	0.149	0.025	1714.02
SHEETA	92 (9.62)	17.44	17.34	0.149	0.026	1657.92
SP1	96 (9.82)	19.01	15.43	0.130	0.017	1543.50
SP2	98 (9.92)	17.26	14.26	0.129	0.017	1405.32
SP3	91 (9.57)	19.34	14.89	0.137	0.025	1339.52
SP5	98 (9.92)	19.55	16.34	0.147	0.026	1595.44
SP6	98 (9.92)	20.24	15.55	0.144	0.025	1508.22
SP7	80 (8.97)	15.43	15.78	0.135	0.023	1208.68
TORI LOCAL	92 (9.62)	13.16	20.04	0.137	0.024	1788.82
WHITE FLOWER	92 (9.62)	16.59	16.78	0.176	0.029	1452.48
MEAN	94 (9.72)	18.19	17.07	0.144	0.023	1579.30
SEm (±)	1.053	0.259	0.248	0.002	0.001	22.924
CD at 5%	3.004	0.738	0.709	0.006	0.001	65.425

Table 1.2: Identification of genotypes through physiological parameters (2013-14)

Genotypes	Germination (%)	Speed of	Seedling length	Fresh	Dry seedling	Vigour index
AGRANI	98 (9.92)	17.24	15.76	0.125	0.018	1544.48
BENOY	98 (9.92)	17.48	16.69	0.144	0.022	1635.62
JHUMKA	96 (9.82)	15.92	18.85	0.189	0.031	1809.60
MULTI	96 (9.82)	17.30	12.66	0.151	0.029	1215.36
NRCYS	92 (9.62)	18.55	19.12	0.167	0.027	1759.04
PANCHALI	90 (9.51)	20.75	16.51	0.122	0.016	1485.90
PT 303	82 (9.08)	18.33	17.08	0.127	0.019	1400.56
RW 351	96 (9.82)	20.40	16.92	0.121	0.017	1624.32
RAJENDRA	98 (9.92)	21.18	19.24	0.205	0.033	1885.52
SAMRAT	98 (9.92)	20.26	18.66	0.126	0.019	1828.68
SANJUKTA	84 (9.19)	19.17	20.98	0.128	0.022	1762.32
SAROMA	98 (9.92)	22.20	17.49	0.149	0.026	1714.02
SHEETA	96 (9.82)	20.05	17.27	0.143	0.024	1657.92
SP1	98 (9.92)	19.34	15.75	0.129	0.016	1543.50
SP2	98 (9.92)	17.19	14.34	0.126	0.017	1405.32
SP3	92 (9.62)	19.45	14.56	0.135	0.025	1339.52
SP5	98 (9.92)	19.54	16.28	0.112	0.017	1595.44
SP6	98 (9.92)	20.15	15.39	0.148	0.025	1508.22
SP7	82 (9.08)	15.91	14.74	0.137	0.026	1208.68
TORI LOCAL	94 (9.72)	13.74	19.03	0.136	0.025	1788.82
WHITE	96 (9.82)	18.59	15.13	0.174	0.028	1452.48
MEAN	94 (9.72)	18.70	16.78	0.143	0.023	1579.30
SEm (±)	0.965	0.266	0.244	0.002	0.001	22.924
CD at 5%	2.754	0.758	0.698	0.006	0.002	65.425

***Figures in parentheses are Square root transformed values**