Effect of different doses of N, P and K fertilisers on seed storability of Indian mustard (Brassica juncea L.)

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Abstract
The present investigation was carried out with the objective to study the effects of different doses of fertilisers on seed storability of the Indian mustard variety NRCHB-101. The field experiment was conducted during 2016-17 at the Agronomy Main Research Station, OUAT, Bhubaneswar laid out in a Factorial Randomized Block Design with three replications and twelve treatments i.e. three levels of nitrogen (N1=80, N2=100 and N3=120 kg/ha), two levels of phosphorus (P1=20 and P2=40 kg/ha) and two levels of potassium (K1=0 and K2=30 kg/ha). The freshly harvested dried seeds were subjected to accelerated aging process and the seed storability parameters viz. germination percentage, seedling length and vigour index were studied. Seed storability was found to be significantly affected by NPK fertiliser doses. After accelerated aging test, highest level of germination percentage, seedling length and vigour index were observed at N2 which was significantly higher than N1 and N3. Lower level of phosphorus (P1) showed higher germination percentage and lower seedling length, whereas the effect of phosphorus was non-significant on vigour index. Higher level of potassium (K2) showed high germination percentage, seedling length and vigour index. The combined interaction of N-P-K revealed that highest germination percentage, seedling length and vigour index were observed under N2P2K1, whereas lowest values were obtained at N1P0K1.

Keywords: Indian mustard, doses of fertiliser, seed vigour, seed storability

Introduction
Among the seven edible oilseeds cultivated in India, rapeseed-mustard ranks second after groundnut contributing 28.6% of the total oilseed production and sharing 27.8% in the India’s oilseed economy [11]. The average annual production of rapeseed-mustard is about 8.17 Mt from an area of about 6.51 Mha with a total productivity of 12.57 q/ha [3]. Indian mustard (Brassica juncea) is an important winter season rabi crop. Out of total cropped area in India, oilseeds account for 14.1% out of which rapeseed-mustard shares 3% [10]. India’s total rapeseed-mustard seed output i.e. 7.6 Mt in 2020 which is nearly 25% lower than 2019, while the Ministry of Agriculture in its third advanced estimated projected total output at 8.7 Mt for the recently ended rabi harvesting season from 9.2 Mt in the same season of the last year [2]. The gap between the production and demand of mustard is progressively increasing and the situation warrants to increase the production. Among different production factors seed and its storage play an important role. The storability of Indian mustard seed has not been adequately studied yet.

Balanced fertilizer application helps in better yield and quality seed production. In oil seed crops, protein levels are increased upon nitrogen fertilization, whereas oil concentration is decreased. N input increases the rate of conversion of carbohydrates in to protein which in turn important in the structure of protoplasm producing vigorous [9]. Potassium is responsible for the transport mechanisms in the plant whereby materials made by photosynthesis in the leaf can be moved to other parts of the plant for growth, formation of seed and deposition of oil. This nutrient is nevertheless vital for vigorous, healthy crop growth and profitable yields. Phosphorus plays an important role for improved crop establishment, winter hardiness, and yield in oilseeds.
From various research conducted on oilseeds crops viz. groundnut, soybean and safflower, it has been reported that balanced fertilizer application of N, P, K increases not only the seed yield but also the seed quality parameters. Soybean plants grown without potassium fertilization matured later than those receiving adequate potassium and K fertilization almost always decreased seed pathogen levels [6]. Seed viability and vigour of soybean seed lots grown with high levels of potassium fertilization remained high for first few months in poor storage conditions which are consequently followed by a rapid decrease in vigour levels [7]. Sesamum seeds produced from 60:20:30 kg NPK/ha + sulphur (10 kg/ha) fertilizer level maintained lower seed infestation at the end of six month of storage period as compared to control [12]. However the information on effect of NPK on seed storability in Indian mustard is very scanty.

Taking in to considerations the above facts, the present investigation on Indian mustard hybrid NRCHB-101 was conducted with an objective to study the seed storability of the variety under different fertility levels.

Materials and Methods

The field experiment was conducted during rabi 2016-17 at the Agronomy Main Research Station, Odisha University of Agriculture and Technology, Bhubaneswar (20026'N, 85081'E, 25.9m above MSL), Odisha. The soil of the experimental field was sandy loam acidic (pH 5.4) medium in organic carbon (0.628%) and available nitrogen, phosphorus and potassium were 1673.3, 64.5 and 123.4 kg/ha respectively. The experiment was laid out in a Factorial Randomized Block Design with three replications. Twelve treatment combinations comprising three nitrogen levels (80, 100, 120 kg N/ha), two phosphorus levels (20, 40 kg P_2O_5/ha) and two potassium levels (0, 30 kg K_2O/ha) were tested in the experiment. Indian mustard variety ‘NRCHB-101’ was sown 30 cm row spacing. Thinning was done as 15 DAS to maintain plant to plant distance of 10 cm. All the recommended agronomic practices were done throughout the crop season. The crop was sown on 20th November and harvesting was done manually during last week of February.

The storability of mustard seeds produced under different treatments was studied by accelerated aging test. Seeds belonging to different treatments were exposed to 100% RH and 40±4°C temperature in the accelerated chamber for 7 days. The treated seeds were brought out of the chamber and kept under laboratory condition for assessment of germination percentage, seedling dry weight and vigour. After accelerated aging, germination test was conducted by T.P. method [5] expressed in percentage. 10 numbers of normal seedlings from aged seeds were selected randomly from each treatment and the shoot & root portion of the seedlings were measured separately with the help of centimeter scale and average length of both root and shoot was calculated. Vigour index values of seeds produced under different treatments were calculated as per the formula developed by Abdul Baki and Anderson [11] using the following formula.

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\text{Vigour Index} = \frac{\text{Seedling length (cm) \times Germination percentage}}{100}
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Data collected on various observations on Indian mustard were analyzed statistically by following standard analysis of variance technique (ANOVA) as described by Gomez and Gomez [4]. Test of significance of the treatment differences was done on the basis of ‘F’ test. The differences between treatments were compared with critical difference at 5 per cent level of significance (P= 0.05).

Results and Discussions

The seed storability parameters like germination percentage, seedling growth and vigour index of aged seeds of all the seed lots harvested from all the different levels of NPK treatments and their interactions were studied by exposing the seeds to accelerated ageing process. Accelerated aging caused by exposing the seeds to an unfavourable hot and moist atmosphere is representative of natural ageing. The performance of seeds in form of germinability after accelerated aging of seeds indicates storage potential of seed lots.

Data on effects of sole application of N, P & K, their interaction effects viz. N-P, P-K & N-K and the combined interaction effects i.e. N-P-K on germination percentage, seedling length and vigour index of Indian mustard are presented in Table 1, 2 and 3 respectively. The germination percentage of different seed lots receiving accelerated ageing reduced to variable extent.

From the experiment it was observed that the 3 nutrients have different effects on the germination percentage of accelerated aged seeds. Numerically higher germination (59.33%) was found at N_2 which significantly differed from N_1 (57.83%) and N_3 (57.50%). Here it was observed that at highest dose of nitrogen the germination percentage decreased whereas, different results were observed in phosphorus and potassium. Seeds obtained from lower level of phosphorus (P_1) and higher level of potassium (K_2) showed high germination percentage i.e. 60.05% and 65.94% respectively. Among the P-K interactions, significantly higher germination (71.7%) was witnessed in case of P_1 K_2.

Among all interactions significantly highest germination is observed (73.2%) at N_2 K_2. Out of the N-P-K interactions, significantly higher germination (76.33%) was found in N_2 P_2 K_2. Significantly lowest germination was witnessed with N_3 P_2 K_1 (40.0%). The storability of seeds decreased with high level of phosphorus has been founded in onion [8] and in soybean [7].

Among the sole effects of N, P & K, lower seedling length (6.31 cm) was observed under the highest level of N (N_3) and higher seedling lengths i.e. 7.15 cm and 8.03 cm were observed under higher levels of P (P_2) and K (K_2) respectively. Among the P-K interactions, significantly higher seedling length (8.1 cm) was witnessed in case of P_1 K_2 which was similar with that of N_1 P_1 K_2 interaction. Significantly the highest seedling length (10.4 cm) was observed at N_3 K_2. Among combined N-P-K interactions, significantly highest seedling length (11.10 cm) was found in N_3 P_2 K_2. Significantly lowest seed length was witnessed with N_1 P_1 K_1 (2.77 cm). The treatment which maintained to occupy top ranking in respect of germination also exhibited comparatively greater seedling growth. Sole application of N, P and K exhibited significant influence on vigour index. Significantly higher vigour index was observed under N_2 (455.69) followed by N_1 (412.80) and N_3 (400.25). There was no significant effect of sole P levels on vigour index, whereas K_2 had significantly higher vigour index (533.57) than the control or K_1 (312.25). Among all the two factor interactions, significantly highest vigour index was found at N_2 K_2 (661.9).

As far as the combined NPK interactions are concerned, significantly highest and lowest vigour index were recorded at N_2 P_2 K_2 (780.87) and N_1 P_3 K_1 (116.60) respectively. Similar results were also observed in soybean [7].
With increase in doses of nitrogen fertilizers, the seed storability increased up to 100 kg/ha, whereas phosphorus has shown no significance in seed vigour with increase in dose, rather lower level of phosphorus showed better vigour index and increase in potassium dose resulted in better seed storability.

**References**


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