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Role of phytohormones on seedling growth characteristics of different varieties of oil seeds and pulses

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Abstract
Present investigation was undertaken to see the effect of different plant hormones like GA_3 and ABA on germination and other seedling characters of cultivars of oil seed and pulses. Seed treatment with GA_3 and ABA at the concentration 10^{-3} M was provided for 2 hours. After that treated and control seeds were placed in square glass plate with three replications and placed inside germinator. After germination in case of oil seed, Jhumka (V_1) recorded the highest germination percentage (94.11%) for T_1 followed by T_2 and lowest germination percentage (91.87%) was recorded for control. For the variety Bhagirathi (V_2) a slight decrease in germination was recorded in case of T_2 than control, whereas, T_1 recorded the highest of it (97.26%). For pulses, Goutom (V_3) recorded highest value of germination percentage for T_1 and lowest value for the T_2. For V_4, T_0 was found with highest germination percentage followed by T_2 and T_1. Seedling shoot length (cm) of V_1 was the highest in case of T_1 followed by T_0 and slight decrease was noticed for T_2 where the value was 8.95 cm. In case of V_2, highest seedling shoot length was noticed for T_1 and lowest (7.91 cm) for T_0. For V_3, T_1 was observed with highest value followed by T_0 whereas T_2 recoded lowest value. In case of V_4, it obtained the highest seedling shoot length (12.74 cm) for T_1 and the lowest (9.10 cm) for T_0. Seed treatment with ABA though recorded small increase in some of the seed and seedling parameters but it cannot be recommended for seed treatment of different cultivars or varieties of oil seed and pulses. Seed treatment with GA_3 in most of the cases both for oil seed and pulses enhanced characters like germination percentage, seedling length, vigour index etc. than control, indicating use of GA_3 for better performance of oil seed and pulses. So, seed treatment with GA_3 at the concentration of 10^{-3} M can be recommended to farmers for better seedling growth in case of pulses and oil seeds.

Keywords: GA_3, ABA, germination percentage, vigour

Introduction
Rapid deterioration of stored seed is a serious problem in India where the high temperature and high relative humidity greatly accelerate the process of ageing. The control of temperature and humidity during storage has a profound influence on vigour and viability of seeds but such facilities are presently not available to all seed producers and small cultivators. Chemicals like p-amino benzoic acid are known as free radical quenching agents. These chemicals have the capacity to slow down loss of viability (Basu, 1976) [2]. Seeds of *rabi* crops, like wheat etc., pass through the hot and humid monsoon season in Eastern India, resulting in a significant loss of viability. The beneficial effects of water soaking and seed chemical treatments on maintaining viability are yet to be clarified. Seed invigoration for imparting resistant to stress conditions has been strongly advocated by Henckel (1961) [3]. Salim and Todd (1968) [8] pointed out that there could be no generalization and the concentration of chemicals had to be decided crop wise. Heydecker (1972) [5] believed that seed could be invigorated with hormonal treatments. The complex growth and development of a plant depends on plant growth hormones. Synthetic growth regulating hormones are also important in regulating the growth and development of agricultural, horticultural and silvicultural crops. These Exogenous hormones change the endogenous levels of the naturally occurring hormones and allow for desired modifications. Growth hormones include auxins, gibberellins, cytokinins, abscisic acid, ethylene, jasmonic acid, salicylic acid, brassinosteriods. These hormones play a major role in controlling the ontogenesis of plant growth such as shoot, root and differentiation of plant parts, initiation of cambial activity, xylem differentiation, annual ring formation, in junction of flowering, fruit set, altering flowering by morphological modification, seed development, seed yield and quality. Present investigation was undertaken to see the effect of different plant hormones like GA_3 and ABA on germination and other seedling characters of cultivars of oil seed and pulses.

Materials and Methods

Various seed quality parameters of two oil seed varieties i.e. NC-1 (Jhumka) as V_1 and Bhagirathi as V_2 along two varieties of pulses i.e. Goutom as V_3 and Sarada as V_4 with treated with three treatments i.e. GA_3 (10^{-3} M) as T_1, ABA (10^{-3}M) as T_2 and control as T_0 were taken as follows-

Germination percentage: Petridish method was followed to evaluate the germination percentage of four varieties treated with three treatments as discussed earlier. Germination percentage was calculated by following formula-

Germination percentage = (Number of seeds germinated/Total number of seeds sown)*100

Seedling length (square glass plate method): To avoid any obstruction, overcrowding or intermingling of seedlings, glass plates are used, where 10 seeds with equal spacing were kept. At first the glass plates were wrapped with blotting paper and the seeds are placed on that. Then the wrapped glass plates were covered by plastic bags with adequate moisture and placed in glass plate slanted plastic stand. Then the trays were placed in germinator with temperature (26±1) ˚C for 10 days. After 10 days, they were taken out and the individual seedling was plucked out from the blotting paper and the seedling length was measured with a cm scale and accordingly the average length of root and shoot per replication was noted down. Here, root length and shoot length were taken into account separately for better information.

Seedling fresh weight: After measuring the length of 10-day old seedling i.e. lengths of shoot and root, seedlings were surface dried with the help of blotting paper. The fresh weight (g) was noted in a weight balance with so care that minimum water should not be adhered to the seedlings.

Seedling dry weight: After measuring the seedling length (cm) and fresh weight (g), the seedlings were cut and dried at (65-70)˚C for 2 days and then dry weight (g) of seedlings was taken. Seedlings having higher dry weight were considered to have higher vigour. Higher dry weight means high dry matter accumulation in seedling which is highly desirable in seedling because it is a very important fraction of vigour.

Vigour index: Seed vigour means the strength of the seeds to cope up with the adverse situations of its surroundings and ultimately gives effective plant stand in field. Seed vigour determines the activity and performance of seed lots. For judging this seed vigour, rate and uniformity of seed germination and seedling growth, emergence ability of seeds under favourable environmental condition and performance after storage were considered.

Statistical analysis: The experimental data were subjected to Analysis of Variance as per design i.e., CRD (Completely Randomized Design). The Critical Differences (C.D.) at 5% Level of Significance was worked out for comparing various treatment means, whenever the F value in ANOVA was found to be significant. The Standard Error of Means (SEm) was also calculated.

Results and Discussions

Seed treatment with GA_3 and ABA at the concentration 10^{-3} M was provided for 2 hours. After that treated and control seeds were placed in square glass plate with three replications and placed inside germinator. After germination in case of oil seed, Jhumka (V_1) recorded highest (94.11%) germination percentage for T_1 (GA_3) followed by T_2 (ABA) and lowest germination percentage (91.87%) for the same was recorded for control (Table-1). For the variety Bhagirathi (V_2), a slight decrease in germination was recorded in case of T_2 than control whereas, T_1 recorded the highest (97.26%). For pulses, Goutom (V_3) recorded highest value of germination percentage for T_1 that is 96.06% and lowest value for the T_2 which is 93.29%. For V_4 (Sarada), the highest germination percentage was obtained at T_0 (96.32%) followed by T_2 (96.20%) and T_1 (96.02%).

After 10 days of growth inside germinator, seedling root length of control and treated seeds were measured. V_1 recorded highest root length at T_1 which is 12.26 cm and lowest of it (9.16 cm) was recorded for control that is T_0. Root length of 8.14 cm, 7.57 cm and 7.94 cm was obtained by V_2 at T_1, T_2 and T_0, respectively (Table-2). Similar results were reported by Basra *et al.* (2005) [1] in wheat. The V_3 variety recorded the lowest seedling root length of 10.78 cm and highest seedling root length of 12.47 cm, observed at control and T_2, respectively. The V_4 obtained highest root length in case of T_1 (9.17 cm) followed by T_0 (9.12 cm) and slight decrease in seedling root length for the same was noticed for T_2 (8.28 cm). The reason behind this may be due to ABA which is a growth retardant.

Seedling shoot length of control and treated seeds recorded for the four mentioned varieties is represented in Table-3. Both V_1 and V_2 obtained the highest seedling shoot length of 12.26 cm and 11.87 cm, respectively in case of T_1. However, V_1 recorded lowest seedling shoot length at T_2 which is 8.95 cm and V_2 at T_0 which is 7.91 cm. The V_3 variety recorded the highest value of it (11.86 cm) at T_1 followed by T_0 (9.09 cm) whereas T_2 recorded lowest value (8.14 cm). In case of V_4, highest seedling length (12.74 cm) and lowest seedling length (9.10 cm) was obtained at T_1 and T_0, respectively.

Vigour index for all the four varieties at control and treatments is shown in Table-4. Vigour index for V_1 was recorded highest (2016.30) at T_1 and lowest (1844.90) at T_2. In case of V_2 also, highest and lowest vigour index was recorded for T_1 (1925.73) and T_2 (1398.02), respectively. Highest vigour index in V_3 was recorded for T_1 and lowest for T_0. For V_4, T_1 recorded highest value and lowest value for T_2. Farooq *et al.* (2011) [7] reported similar results in wheat.

While considering seedling fresh weight, V_1 when treated with GA_3 that is T_1 recorded maximum value (0.26 g) followed by T_0 (0.24 g) and minimum value was found for T_2 (0.18 g). In case of V_2 maximum and minimum seedling fresh weight was obtained in T_0 (0.26 g) and T_2 (0.21 g), respectively. V_3 obtained highest seedling fresh weight at T_1 (0.27 g) followed by T_0 (0.25 g) and T_2 (0.24 g). The variety V_4 recorded same seedling fresh weight of 0.25 g at T_2 and T_0, with the highest of it at T_1 which is 0.28 g (Table-5). Increase of root and shoot length by application of IBA and GA_3 along with salicylic acid was reported by Ghodrat *et al.* (2013) in rice.

Seedling dry weight recorded by V_1 was 0.05 g, 0.05 g and 0.04 g for T_1, T_2 and T_0, respectively (Table-6). Similar higher values of seedling dry weight were obtained by V_2, in case of both T_1 and T_2 which is 0.04 g, whereas lower value of it at T_0 (0.03 g). In case of V_3 similar dry weight of 0.05 g was recorded for all the treatments and in case of V_4, T_1 and T_2 both helped to attain higher dry weight of 0.05 g, whereas least value was found for T_0 (0.04 g). Similarly in case of wheat seeds when treated with Kinetin and GA_3 there was

increase in germination, radicle and plumule length and seedling dry weight (Khan *et al.*, 2011) [6].

Table 1: Germination percentage of seeds at control and treatments

Treatment	V_1	V_2	V_3	V_4
T_1	94.11	97.26	96.06	96.02
T_2	93.16	86.83	93.29	96.20
T_0	91.87	92.82	93.98	96.32
SEm	0.779	0.864	1.271	0.688
CD at 5%	2.696	2.992	4.399	2.380

Table 2: Seedling root length (cm) of seeds at control and treatments

Treatment	V_1	V_2	V_3	V_4
T_1	11.09	8.14	11.70	9.17
T_2	10.85	7.57	12.47	8.28
T_0	9.16	7.94	10.78	9.12
SEm	0.584	0.539	0.656	1.090
CD at 5%	2.020	1.865	2.270	3.771

Table 3: Seedling shoot length (cm) of seeds at control and treatments

Treatment	V_1	V_2	V_3	V_4
T_1	12.26	11.87	11.86	12.74
T_2	8.95	8.52	8.14	9.36
T_0	9.02	7.91	9.09	9.10
SEm	0.279	0.315	0.227	0.694
CD at 5%	0.965	1.090	0.785	2.401

Table 4: Vigour index of seeds at control and treatments

Treatment	V_1	V_2	V_3	V_4
T_1	2016.30	1925.73	2261.98	2103.75
T_2	1844.90	1398.02	1932.78	1699.93
T_0	1846.76	1492.59	1926.99	1754.73
SEm	3.861	5.424	4.698	5.111
CD at 5%	13.360	18.755	16.257	17.686

Table 5: Seedling fresh weight (g) of seeds at control and treatments

Treatment	V_1	V_2	V_3	V_4
T_1	0.26	0.24	0.27	0.28
T_2	0.18	0.21	0.24	0.25
T_0	0.24	0.26	0.25	0.25
SEm	0.018	0.025	0.018	0.044
CD at 5%	0.062	0.086	0.062	0.152

Table 6: Seedling dry weight (g) of seeds at control and treatments

Treatment	V_1	V_2	V_3	V_4
T_1	0.05	0.04	0.05	0.05
T_2	0.05	0.04	0.05	0.05
T_0	0.04	0.03	0.05	0.04
SEm	0.018	0.025	0.018	0.018
CD at 5%	0.062	0.086	0.062	0.062

Conclusion

Rapid seed deterioration is a serious problem in India. In this present study, seed treatment with ABA though recorded small increase in some of the seed and seedling parameters but it cannot be recommended for seed treatment of different cultivars or varieties of oil seed and pulses. Seed treatment with GA_3 in most of the cases both for oil seed and pulses enhanced characters like germination percentage, seedling length, vigour index etc. than control indicating use of GA_3 for better performance of different varieties of oil seed like Jhumka, Bhagirathi and pulses like Goutom and Sarada. So, seed treatment with GA_3 at concentration 10^{-3} M can be recommended for farmers for better seedling growth in case of oil seed and pulses.

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