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EFFECT OF GROWTH REGULATORS ON GERMINATION AND SEEDLING GROWTH OF *PINUS KESIYA* ROYLE ex GORD. AND *SCHIMA KHASIANA* DYER

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Abstract

The effect of growth regulators on seed germination and seedling growth of *Pinus kesiya* and *Schima khasiana* was studied. The growth regulators, viz., IAA (25 mg/l), GA (150-200 mg/l) FAP (1 mg/l) and AA (25-50 mg/l) enhanced the seed germination and speeded the rate in *P. kesiya*. 2, 4-D increased the rate as well as percentage of germination at 25 mg/l and 100 mg/l, respectively. In *S. khasiana*, the soaking of seeds in IAA (10 mg/l), 2, 4-D (25 mg/l), GA (25 mg/l), FAP (0.1 mg/l) and AA (10 mg/l) enhanced seed germination. 2, 4-D produced abnormal seedlings in both the species. Comparative study of different growth regulators on seed germination and subsequent seedling growth revealed that GA and FAP were highly effective in *P. kesiya* and *S. khasiana*. respectively.

Introduction

Growth regulators have been implicated to promote seed germination and growth performance in a number of species (Khan 1977; Thomas 1981; Mohanna *et al.*, 1985). During the storage of seeds, the reduction in quantity of hormones and vitamins or accumulation of growth inhibitory substances have been reported. The application of growth stimulatory substances antagonize the effect of growth inhibitory substances and also intensify the metabolism during germination (Ovcharov 1969; Khan 1977). In commercial crop production, where high yields and uniform produce are two main considerations, slow and variable seedlings can be a major problem (Dunlap and Barnett 1982). Rapid, uniform and complete germination are pre-requisites for achieving good plant populations from the seeds. Hence, the present study was initiated to understand the behaviour of growth regulators on seed germination and subsequent seedling growth of one-year-stored seeds of *Pinus kesiya* Royle ex Gord. and *Schima khasiana* Dyer-two economically important tree species of high altitude of North-East India.

Abbreviations Indole-3-acetic acid (IAA), 2, 4-Dichlorophenoxy-acetic acid (2, 4-D), Gibberellic acid (GA), 6-Furfurylaminopurine (FAP), Ascorbic acid (AA).

Material and Methods

Seeds of *Pinus kesiya* Royle ex Gord. and *Schima khasiana* Dyer were collected from University Campus, Shillong and Upper Shillong, India (Lat. 25°35′ N Long. 91°56′ E, Alt 1500-1800 m) respectively, during February-March, 1983, and stored for approximately one year under laboratory conditions (15-22°C). *P. kesiya* seeds were soaked in IAA (1-100 mg/l), 2, 4-D (10-200 mg/l), GA (10-250 mg/l), FAP (0.5-10 mg/l) and AA (1-100 mg/l) solutions. *S. khasiana* seeds were soaked in IAA (1-100 mg/l), 2, 4-D (10-100 mg/l), GA (1-100 mg/l), FAP (0.05-1.0 mg/l) and AA (1-50 mg/l). After soaking, the seeds were thoroughly washed 4-5 times with sterilized distilled water. Twenty seeds were placed equidistant in each covered petri dishes (9 cm diam.) containing sterilized moist filter paper. Each concentration consisted of four replicates and experiments were performed twice Germination was carried at 25±2°C under 3 lux light for 16 hr in *P. kesiya* while in *S khasiana* at 20±1°C under 25 lux light for 8 hr day length.

Germination was recorded from 6th-20th day at 2-day interval. The percentage germination (based on viable seeds) after angular transformation, rate of germination (% seed day^{-1}) and days to peak value were calculated as mentioned earlier (Verma and Tandon, 1984). Comparative growth as influenced by growth regulator treatments were also calculated on 20th day. Statistical analysis were performed wherever necessary (Snedecor 1961).

Results

All the concentration of growth regulators used, promoted germination of *P. kesiya* and *S. khasiana* seeds. Seeds treated with IAA (25 mg/l), GA (150-200 mg/l), FAP (1 mg/l) and AA (25-50 mg/l) showed better germination percentage, rate and also lower days to peak value in *P. kesiya* as compared to control (Table-1). On the other hand, better germination percentage and rate resulted in 2, 4-D treatment at 100 mg/l and 25 mg/l concentrations, respectively. Treatment of *S. khasiana* seeds with IAA (10 mg/l), 2, 4-D

Table-1. Effect of IAA, 2, 4-D, GA, FAP and AA on seed germination in *Pinus kesiya*.

Treatment (concentration mg/l)	Germination %	Germination rate (% seed day^{-1})	Days to Peak value
Control	75.00±4.80	21.30±2.00	4.35
IAA			
1	75.00±4.60	30.80±1.60	4.10
10	75.00±6.70	32.10±1.60	3.80
25	88.50±5.20*	33.90±4.20*	3.75
50	86.25±6.00	27.10±1.80	5.50
100	86.25±5.20	26.60±0.60	5.80
2, 4-D			
10	75.00±5.00	28.30±6.50	5.40
25	75.00±2.25	43.20±8.30*	3.20
50	83.50±3.25	37.70±3.50*	3.90
100	92.50±3.40*	33.50±3.20	4.60
200	88.80±5.90	35.10±1.50	5.00
GA			
10	81.50±5.00	35.10±1.50	4.00
25	81.50±4.20	35.30±4.60	2.50
50	81.50±4.20	40.00±5.60*	2.25
100	82.50±8.75*	44.50±2.50*	2.20
150	95.25±2.70*	54.50±2.50*	1.80
200	97.50±2.50*	53.50±3.20*	1.80
250	94.00±5.50*	48.50±5.00	2.00
FAP			
0.5	87.50±2.75	34.50±1.25	4.00
1.0	93.50±2.75*	43.90±4.20*	1.90
5.0	73.50±6.50	43.90±5.20*	2.00
10.0	71.00±2.25	37.10±4.25	2.50
AA			
1	75.00±3.40	34.50±1.50	4.00
10	81.50±4.00	41.80±2.75*	3.00
25	95.00±4.30*	48.00±9.00*	2.00
50	90.00±3.00*	47.90±6.00*	2.25
100	81.50±5.00	35.80±1.40	3.80

± SE

* Significant at $p \leq 0.05$ level.

(25 mg/l), GA (25 mg/l), FAP (0.1 mg/l) and AA (10 mg/l) resulted in higher germination percentage, rate and lower days to peak value as compared to control (Table-2). There was a decrease in germination with growth regulator treatments beyond the aforesaid concentrations. Maximum germination percentage, rate and least days to peak value were recorded using GA and FAP in *P. kesiya* and *S. khasiana*, respectively.

Table-2. Effect of IAA, 2,4-D, GA, FAP and AA on seed germination in *Schima khasiana*.

Treatment (concentration mg/l)	Germination (%)	Germination rate (% seed day^{-1})	Days to Peak value
Control	25.00±4.70	16.80±2.10	5.35
IAA			
1	25.00±4.40	16.80±2.25	5.30
10	36.20±2.00*	18.90±2.25*	4.80
25	29.10±3.25	15.30±1.85	5.90
50	25.00±3.25	13.00±3.25	7.70
100	25.00±3.80	13.00±3.25	7.70
2, 4-D			
10	25.00±3.90	18.20±4.60	4.00
25	30.00±5.40*	21.60±3.90*	3.95
50	24.50±5.20	14.30±3.25	5.30
100	22.00±5.20	13.50±1.00	7.10
GA			
1	25.00±3.25	19.60±2.25	4.55
10	25.00±3.25	23.20±3.10*	3.80
25	33.10±3.80*	26.20±2.25*	3.60
50	24.50±3.80	19.60±2.10	4.70
100	24.50±3.80	16.70±1.50	5.65
FAP			
0.05	36.50±2.20*	30.60±3.00*	3.15
0.10	45.00±2.40*	37.60±4.10*	2.45
0.50	38.00±3.25*	29.50±3.10*	3.10
1.00	36.50±1.50*	22.00±2.00	4.25
AA			
1	30.00±3.80*	20.70±2.20	4.45
10	33.50±5.00*	29.20±3.10	3.15
25	25.00±3.25	21.60±3.40	3.95
50	25.00±2.00	18.30±1.70	5.10

± S.E.

* Significance at $p \leq 0.05$ level.

Comparative study of various growth regulators on seedling growth in *P. kesiya* revealed that GA and AA treatment resulted in higher radicle and shoot elongations whereas higher cotyledon growth was noted in FAP and AA treatments. In *S. khasiana*, FAP and AA treatments resulted in maximum cotyledon expansion and radicle elongation, respectively. However, higher shoot elongation was observed in GA and FAP treatments (Fig. 1). A reduction in the growth of seedling was found in 2, 4-D treated seeds of both the species exhibiting the abnormal appearance. The dry weight of seedlings was maximum in GA and FAP treated seeds of *P. kesiya* and *S. khasiana* respectively.

Discussion

In general, storage of seeds results in partial loss of viability due to disturbances in metabolism and deficiencies of certain chemicals (Ovcharov 1969; Khan 1977). GA, kinetins, ABA, auxins, ethylene, vitamins and other regulatory substance are vitally important and their application to seeds intensify the metabolism and improve germination and plant productivity (Bonner 1976; Mahanna *et al.*, 1985; Singh 1985). During the present study, one year-stored seeds of *P. kesiya* and *S. khasiana* showed better germination when treated with various growth regulators, viz., IAA, 2, 4-D, GA, FAP, and AA. The stimulation of seed germination by growth regulators has been reported in a number of woody plants (Shibakusa 1980; Tinus 1982; Mahanna *et al.*, 1985; Singh 1985). It is noted that germination response of seeds growth regulators is highly variable which generally depends upon both the external and internal factors. The growth regulators may easily penetrate the seeds at their optimum concentration and also be available at the site of action (Bonner 1976; Tinus 1982). The

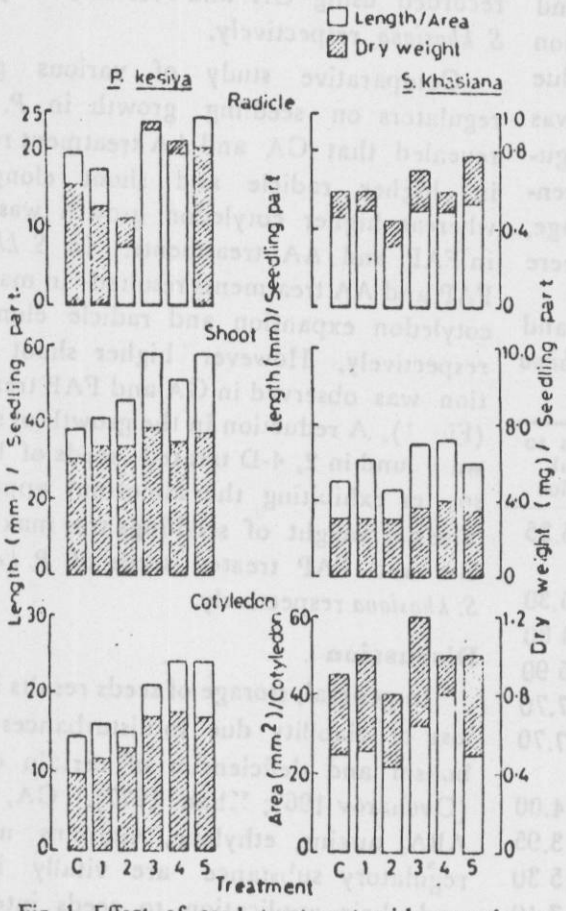

Fig. 1. Effect of seed treatment with growth regulators on seedling growth of *Pinus kesiya* and *Schima khasiana*.

C= control, (1) IAA, (2) 2, 4-D, (3) GA, (4) FAP and (5) AA.

higher germination in *P kesiya* and *S. khasiana* were obtained with GA (150 and 200 mg/l) and FAP (0.1 mg/l) treatments, respectively. The seeds of both species may lack these concentrations during the beginning of germination in one-year-stored seeds. It is reported that GA (250-1,000 mg/l) application to under developed embryos of sub-tropical species stimulate the seed germination (Grushvitskii and Limar 1965). The increase in cytokinin content of seeds at the beginning of germination has been reported in many cases (Khan 1977). Mehanna *et al.* (1985) reported the enhancement of germination of Nemguard peach seeds by benzylaminopurine. The soaking of tung seeds in solutions of auxins and AA have been reported to improve the seed germination and seedling growth (Chatterjee 1960). The high level of AA content and its utilization in embryonic axes during seed germination was observed (Chinoy *et al.*, 1973).

Plant growth and development are greatly influenced by phytohormones. During the study on seedling growth, GA, FAP and AA were found highly effective in increasing the growth of seedling parts in *P. kesiya* and *S. khasia* . 2, 4-D treatment resulted in abnormal seedlings in both the species which could be due to its phytotoxic effects on seedling development (Wu *et al.*, 1971). Simakin (1966) mentioned that radicle of apple seeds first reacted to IAA, other embryonic parts 2, 4-D and perisperm responded to succinic acid. During the present investigation in *P. kesiya*, GA and AA treatments resulted in maximum radicle and shoot elongations while cotyledon growth was higher in FAP and AA treated seeds. In *S. khasiana* seeds, radicle length and cotyledon expansion were higher in AA and FAP treatments, respectively. Shoot elongation was higher in GA and FAP treatments. A differential response of various seedling parts to different growth regulators was observed in both *P. kesiya* and *S. khasiana*.

It may be concluded that both seed germination and seedling growth of *P. kesiya* and *S khasiana* could be promoted by GA and FAP treatments, respectively.

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