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Effect of Growth Regulators On Seed Germination of Bird of Paradise [*Strelitzia reginae* L.]

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ABSTRACT
Bird-of-paradise or crane flower (Strelitzia reginae) is a native of South Africa and is closely related to the banana. Seeds of this species show meager germination. The aim of this project was to increase the rate of germination with in short time. In this experiment on pretreatment of seeds with plant growth regulators (PGR), ten concentrations i.e., BA @ 100 mgL-1 for 24 hrs, BA @ 300 mgL^{-1} for 24 hrs, BA @ 500 mg L^{-1} for 24 hrs, GA$_3$@ 500 mgL^{-1} for 24 hrs, GA$_3$@ 750 mg L^{-1} for 24 hrs, GA$_3$@ 1000 mgL^{-1} for 24 hrs, Ethrel @ 50 mgL^{-1} for 24 hrs, Ethrel @ 75 mgL^{-1} for 24 hrs, Ethrel @ 100 mgL^{-1} for 24 hrs and control were imposed in complete randomized design with four replications. Significant differences were observed in between the treatments, and the mean germination percentage (78.10) was found to be maximum in the GA$_3$@ 750 mgL^{-1} soaked for 24 hrs and along with days taken for first germination (14.10), days taken for fifty percent of germination (28.00) and days taken for seventy percent of germination (39.20).
Key words: *Strelitzia reginae, germination, plant growth regulators*

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INTRODUCTION

Bird of Paradise (*Strelitzia reginae* L.) being an evergreen perennial herbaceous plant and member of the *Strelitziaceae* family with a diploid chromosome number, 2n=22. *Strelitzia* is a genus of five species native to South Africa and it is grown in regions of moderate sub tropical climate and is cultivated in many parts of the world. Countries growing it majorly on a commercial scale are USA, Israel and South Africa. In the US, at present California is the largest producer, followed by Hawaii (Singh, 2016 and USDA, 2003). Jamaica, Guatemala and other Caribbean countries export it in small quantities. In India, these flowers are grown in the Southern region in places that enjoy a tropical climate, *viz.,* Andhra Pradesh, Karnataka, Tamil Nadu, Maharashtra and Kerala.n Propagation of *Strelitzia* species by seeds is a slow process. Fresh seeds from which the orange aril has been removed must be used, and preferably sown in spring or early summer. Seeds kept under suitable conditions germinate in six to twelve weeks (Hensley *et al*., 1998; Notten, 2002; Burgess, 2004). Seedling establishment can take about six months, producing one plant per seed (Sayers, 2007). Mature plants start flowering only fourth to seventh years onwards (Kantharaju *et al.*, 2008). Poor seed germination is the major limiting factor of *strelitzia reginae* for large scale production and cultivation. Seed germination can be controlled by many factors like natural germination (growth) inhibitors (Taiz and Zeiger, 1991). These are the derivatives of benzoic acid, cinnamic acid, coumarin, naringenin, jasmonic and abscisic acid (ABA). They interrupt gene expression or evoke enzyme inhibition (Karssen et al., 1987; Prochazka, 1998) thus block the responses induced by any of several growth promoters. This inhibition of such physiological responses was removed by the use of certain growth regulators such as indole 3-acetic acid (IAA), gibberellic acid (GA3) and in some cases cytokinins (Phillips, 1962; Wright, 1968). Some plant extracts will inhibit the growth induced by GA_3 in pea and maize seedlings (Corcoran and West, 1968). It has been postulated that seed coat (testa) of many plant species contain considerable amount of germination inhibitor, which prevent their seed germination (EL-Barghathi and EL-Bakkosh, 2005). The application of gibberellins increases the seed germination

percentage by increase of the amino acid content in embryo and they cause release of hydrolytic enzyme required for digestion of endospermic starch when seeds renew growth at germination. GA acts synergistically with auxins, cytokinins and probably with the other plant hormones; what might be called a system approach, or synergism. Therefore, present study was undertaken in laboratory of Indian Institute of Horticulture Research, hessaragatta, bangaluru-89 to asses' earlier germination and increase the rates of germination of Bird of paradise (*strelitzia reginae*)

MATERIALS AND METHODS

The present investigation was conducted at Indian Institute of Horticultural Research, Hessaragatta, Bangalore-89 with an objective to determine the effect of various concentrations of growth regulators, such as Benzleadenine (BA), Gibberellic acid (GA3), Ethrel, on seed germination of Bird of paradise (Strelitzia reginae L.). Four hundred Healthy seeds were at first surface-sterilized with sodium hypochloride (NaOCl) 0.1% per 20 mints. Sterilization of seeds requires a longer exposure to sterilants because they have much thick tissues compared to soft tissues in leaves (North *et al*., 2011) for establishment of zygotic cultures, *S. reginae* seeds were surface-sterilised with 70% ethanol for 30 seconds followed by 1.5% solution of sodium hypochlorite (NaOCI) with two drops of Tween-20 for 15 minutes and then rinsed several times with sterile distilled water (North *et al.,* 2011 and Sudhakara *et al.* 2013). Four hundred seeds were scarified with a solution of HCl @1ml/lt for 1 min and, then, rinsed four times in sterile distilled water (Baes *et al.,* 2001 and Elias Pipinis, 2015). These were placed in moist paper towels that were then rolled and kept in a germination chamber or incubator for germination (here, 40 paper towels had been immersed in water for five minutes and dried for ten minutes before use). The Healthy one year old seeds of experimental plant material i.e., *Strelitzia reginae* L. or Bird of paradise, (perennial in nature), were obtained from IIHR, bangalore. To determine the germination response of Bird of paradise (*Strelitzia reginae* L.) seeds were soaked in different concentrations of three potent plant growth regulators *i.e.* Benzleadenine (BA), Gibberellic acid (GA3), Ethrel, per 24 hours. All treated and control seeds were kept in incubator at optimum temperature (20^0 to 30^0C for 16/8 hrs temperature). Four replicates of 10 seeds were used for each treatment and maintained at 25±2^{o}C temperature in a B.O.D. incubator cum germinator. Seeds were considered to be germinated at the emergence of the radicle (Roychowdhury et al., 2012). Data on rate of days taken for 50% germination, days taken for 70% germination, mean germination percentage, plant height (cm) at 3 months after sowing, girth (cm) at 3 months after sowing, number of leaves/ plant at 3 months after sowing, leaf lamina length (cm), leaf lamina breadth (cm), petiole length (cm), petiole girth (cm) were recorded at weekly intervals. Data collected based on visual scoring/ observation, were analyzed for statistical significance, using Complete Randomised Design (CRD).

Table 1: The treatments of BA, GA3, and Ethrel with their different concentrations

Treatments	Growth hormone	Concentration (ppm)	Seed soaked time (h)
T_1	Control	-	24
T_2	BA	100	24
T_3		300	24
T_4		500	24
T_5	GA_3	500	24
T_6		750	24
T_7		1000	24
T_8	Ethrel	50	24
T_9		75	24
T_{10}		100	24

RESULTS AND DISCUSSION

The days taken to initial germination were found significant among different growth regulator concentrations (Table 2) . Minimum days taken to initiation of germination (14.10) was recorded with treatment T_6 (GA_3 @ 750 mg L^{-1} for 24 hrs), followed by T_5 (GA_3 @ 500 mg L^{-1} for 24 hrs) and T_1 (Control). The Maximum days taken to first germination (18.03) was observed with T_7 (GA_3 @ 1000 mg L^{-1} for 24 hrs). In above mentioned results, treatment (T_4) showed earlier germination. This may be due to the germination begins, when dry seeds were hydrated with water followed by embryo expansion and higher physiological activity of the seed (Finch-Savage and Leubner-Metzger, 2006).

However the number of days taken for fifty per cent of germination was significantly different between the various chemical treatments (Table 2). The lowest number of days (28) were recorded in T_6 (GA_3 @ 750 mg L^{-1} for 24 hrs) and at par with T_5 (GA_3@ 500 mg L^{-1} for 24 hrs). Whereas the maximum germination was recorded was 36.05 days in T_{10} (Ethrel @ 100 mg L^{-1} for 24 hrs).

Table 2: The Days taken to initiation of germination, fifty percent germination, seventy percent germination and Mean germination percentage

Treatment	Days taken to initiation of germination	Days taken for (50%) germination	Days taken for (70%) germination	Mean germination percentage
T_1	15.00	30.51	42.72	74.10
T_2	16.03	32.08	44.82	71.50
T_3	17.03	30.00	42.00	74.20
T_4	17.00	34.00	47.60	70.20
T_5	15.00	29.51	41.32	75.20
T_6	14.10	28.00	39.20	78.10
T_7	18.03	31.00	43.40	71.90
T_8	17.50	34.00	47.60	71.50
T_9	16.00	31.51	44.15	73.20
T_{10}	16.13	36.05	50.47	72.10
S Em ±	0.11	0.29	0.38	0.03
CD (*P=0.05*)	0.31	0.83	1.11	0.10

Among the different growth regulator levels significantly lower number (39.20) of days taken for seventy percentage of germination was recorded in T_6 (GA_3 @ 750 mg L^{-1} for 24 hrs) and maximum number of days were recorded in T_{10} (Ethrel @ 100 mg L^{-1} for 24 hrs).

The results of present study revealed that the highest mean germination percentage 78.10 was recorded in T6 (GA_3 @ 750 mg L^{-1} for 24 hrs) and the lowest mean germination percentage 70.20 was recorded in T4 (BA @ 500 mg L^{-1} for 24 hrs). Internal dormancy is caused by physiological conditions which delay germination and it is affected by internal factors such as an immature embryo and the presence of a plant growth hormone, notably abscisic acid (ABA) (DuPont, 2011). Gibberellic acid (GA_3) is a plant growth hormone that releases seed dormancy and its action is generally considered as antagonistic to ABA. Commercially, GA_3 is applied exogenously to release seed dormancy of many plant seeds.

Pogroszewska (2006) reported that 48 hours incubation of mechanically scarified seeds of *S. reginae* in a solution of GA_3 (800 mg/l) resulted in the greatest number of germinated seeds while seedling elongation was also stimulated (Pabitra *et al.,* 2013 and Renu, 2013).). Singh (2006) also reported that treatment of *S. reginae* seeds with a solution of GA_3 at a concentration of 500 ppm for 48 hours alone and in conjunction with warm water at 50-55°C for half hour improved seed germination. *Strelitzia reginae* seeds can be soaked in a solution of ethrel (2000 ppm) for 48 hours. This will lead to 80% seed germination within the first four to eight weeks. Without ethrel treatment approximately 50% of the seeds should from inoculation and the data presented in Table 10 and Fig.16. In the 4th week of culturing of *Strelitzia reginae* zygotic embryos percentage of contamination were observed and recorded. The lowest contamination percentage (2.9%) was observed in control and it was on par with T_3. The highest contamination percentage (9%) was recorded in T_4 and it was on par with T_1.

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