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Effect of Plant Growth Regulators on Seed Germination and Seedling Vigour in *Asparagus sprengeri* Regelin

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Abstract

Asparagus sprengeri Regelin *is a rounded, herbaceous perennial and used in landscape for its attractive, fine textured foliage. Asparagus sprengeri* Regelin *commonly known as Asparagus fern, which is not a true fern. It reproduces by seed. The active ingredients are present in roots of the plant. Seed germination is slow. Hence, the present investigation was carried out to study the influence of different growth regulators on seed germination, root, shoot and leaf length, weight and vigour index. The seeds were soaked in different growth regulators like Indole-3-Acetic Acid, Indol-3-Butyric Acid, α - naphthalene Acetic Acid and various concentrations of gibberellic acid to evaluate their effect on germination. It was found that GA_3 had a significant effect on germination rate as compared to control, IAA, IBA and NAA during light and dark period. The result indicates that GA_3 at 50 ppm gave best response but as the concentration increased above 60 ppm the germination decreased rapidly and vigour index also decreased during light and dark period.*

Keywords: *Asparagus sprengeri*, growth regulator, seed germination, seedling vigour.

Introduction

Asparagus sprengeri Regelin is described as a spreading perennial herb with a fine texture and stiff, upright habit, belonging to family Liliaceae. The plant grows in the coastal areas in the Southeastern Cape and KwazuluNatal in a wide range of habitats from coastal dunes to open rocky places or woods and in India. The leaves are small and scale like. The flowers are small, white or pinkish and fragrant, fruits which are quite showy bright red in colour about 8mm in diameter containingtypically 3 seeds and is perennial. Few African *Asparagus species* are used as vegetables or for medicinal purpose. The berries cause only low toxicity if eaten and when are crushed, skin irritation occurs for a few minutes[1].

The plant can be propagate by divisions of rhizomatous disc, but for large scale cultivation the use of seeds is preferred. The seed germination is slow. Seed dormancy is common in the Liliaceae, but unfortunately often detected. The seeds are endospermic, the endosperm surrounding the embryo. Low germination test temperatures and /or pre chill treatments generally promote the germination of the dormant seeds. Growth regulators play important role in increasing germination rate of seed. Growth regulators commonly employed for rooting, vegetative propagation and overall yield of several plants. Growth regulators are mostly used for improving the productivity of a large number of agricultural crops, and seed germination. *Asparagus sprengeri* Regelin plant has extensive root system with fairly large tubers. Which are used in nature to provide food during long periods of drought in summer[2]. Very scanty work is done on this aspect in *Asparagus sprengeri* Regelin. There is a need to increase the propagation by seeds. Hence, taking into consideration all this it is intended to undertake the present investigation with an objective increase seed germination and vigour index by use of different growth regulators.

Material and Methods

The seeds of *Asparagus sprengeri* Regelin (Voucher no-ASPSPRDH 1) were collected from private nursery, Amravati during June–July. Germination studies were conducted in small pots. Aqueous solutions (50 ppm) of different growth regulators IAA, IBA, NAA, GA_3 was prepared separately Control was also maintained in parallel with treated material[3]. The seeds were soaked in different growth regulators with 50 ppm concentration for 2-3 hours at 30-35º C before sowing. Likewise various concentrations of GA_3 i.e. 20,40,60,80 and 100 ppm was also used. Seeds were sown in the small pots containing mixture of soil and sand. For each treatment few seeds were taken. Pots were kept for germination at constant temperature i.e. 26 ± 1ºc. The experiment was conducted in total darkness and in light 20 hr. Observations were recorded daily for emergence of radicle, number of days required for germination, number of root, shoot and leaf length and weight. Germination percentage was calculated. The seedling vigour index was calculated by following the formula[4] and represented in tabular and graphical form.

Vigour index

= Root length + Shoot length X germination percent.

(a) Fruits of *A. sprengeri* Regelin

(c) Plantlet developed from treated seeds

(b) Germinated seeds in GA_3

(d) Plantlets with tubers

Figure-1

Table-1
Effect of various treatments of growth hormones on *Asparagus sprengeri* Regelin seeds

Conc in 50 ppm	Germination in light							Germination in dark						
	Germ %	RL cm	RW mg	SL cm	SW mg	LL mm	LW mg	Germ %	RL cm	RW mg	SL cm	SW mg	LL mm	LW mg
Control	30	0.1	241.3	7.5	97.0	1.1	97.1	40	0.2	250.7	7.7	72.1	1.4	103.2
IAA	50	0.4	279.1	7.5	75.7	1.4	109.4	69	0.3	264.5	7.7	89.7	1.6	122.9
IBA	45	0.4	265.4	7.7	93.4	1.6	101.7	54	0.6	271.2	7.9	105.6	1.6	119.2
GA_3	70	0.6	288.7	7.6	81.5	1.7	115.6	87	0.6	279.9	7.8	97.4	1.7	127.7
NAA	40	0.2	259.4	7.0	71.3	1.3	99.2	50	0.3	282.7	7.4	84.9	1.5	110.1

Table-2
Effect of various concentrations of GA_3 on *Asparagus sprengeri* Regelin seeds

Conc of GA_3 in ppm	Germination in light							Germination in dark						
	Germ %	RL Cm	RW mg	SL cm	SW mg	LL cm	LW mg	Germ %	RL cm	RW mg	SL cm	SW mg	LL mm	LW mg
20	50	0.4	274.1	7.4	74.1	1.3	99.4	60	0.5	262.5	7.4	82.4	1.4	123.5
40	55	0.6	287.9	7.5	78.3	1.6	108.7	72	0.7	274.6	7.7	87.5	1.5	127.4
60	75	0.7	291.7	7.7	84.1	1.7	118.9	89	0.8	281.5	8.1	99.1	1.7	128.3
80	40	0.5	269.2	7.4	69.3	1.5	102.1	81	0.6	276.6	7.6	86.2	1.6	120.5
100	35	0.3	258.1	7.1	54.9	1.1	87.4	52	0.3	257.8	7.1	79.3	1.1	103.9

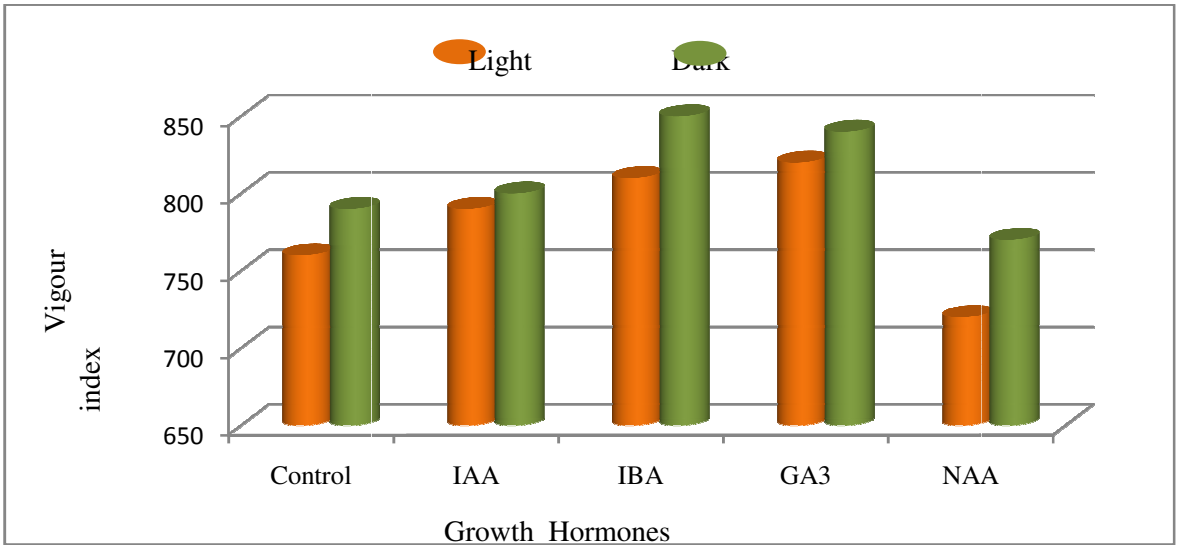

Figure-2
Effect of growth harmones on vigour index in light and dark period

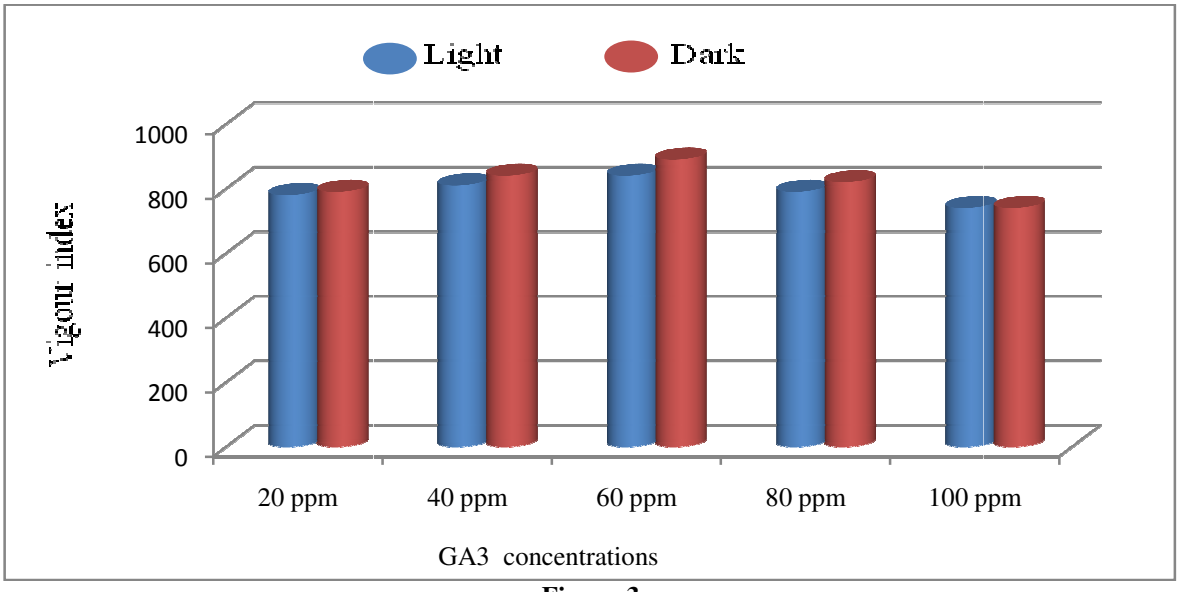

Figure-3
Effects of various concentration of GA_3 on vigour index in light and dark period

Result and Discussion

Recently, various seed priming techniques have been developed, including hydropriming (soaking in water), halopriming (soaking in inorganic salt solutions), osmopriming (soaking in solutions of different organic osmotic), thermopriming (treatment of seed with low or high temperature) biopriming (hydration using biological compounds)[5]. Each treatments has advantages and disadvantages and may have varying effects depending upon plant species, stage of plant development, concentration/ dose of priming agent and incubation period. Earlier reports on seed germination and seed emergence revealed the beneficial effects of seed priming by several ways (heat, smoke, soaking, leaching, temperature, scarification and NaCl salinity[6]. Seed germination and seedling growth are known to be regulated by exogenous hormones[7,8]. Growth regulators used in Presowing seed treatment with growth regulator play an important role in regulating germination and vigour. Seed hardness, which is prevalent in many species belonging to families Leguminosae, Malvaceae and Liliaceae, is one form of dormancy and is caused due to genetic and environmental factors[9]. Seedling emergence of *Asparagus* takes from four to six weeks depending upon temperature and soil water potential. Techniques that speed up germination, such as seed priming, can also enhance seed performance. This technique consists of seed imbibitions in osmotic solutions with sufficient hydration to permit pregerminative metabolic events but insufficient to allow radical protrusion[10]. Foliar spray of different growth regulators resulted in enhanced plant height both above and below ground parts[3].

Out of the four growth regulators GA_3 and IAA had a significant effect on germination in dark rather than light. However, GA_3 was highly effective to induce germination (table 1). Seeds took 21 days for germination in control and 17 days in IAA, IBA and NAA while it started at 13 th day in GA_3 giving early germination comparatively. It was observed that, GA_3 was found to be the most effective in inducing seed germination. No doubt all growth hormones gave better result than control. During light period, the highest root length was observed in GA_3 (0.6 cm) and root weight 288.7 mg. The highest shoot length was observed in IBA (7.7 cm) and shoot weight 93.4 mg. The highest leaf length was observed in GA_3 (1.7 cm) and leaf weight 115.6 mg. During dark period root length was highest in IBA (0.6 cm), root weight 282.7 mg in NAA, Shoot length was 7.9 cm in IBA and shoot weight 105.6 mg in IBA. The highest leaf length was 1.7 cm in GA_3 and leaf weight 127.7 cm in GA_3. Sharma *et al*., has reported that the germination rate of 31 percent for *Asparagus racemosus* under Maharashtra conditions and observed that germination begins only with the commencement of manson in Maharashtra. In Jammu type conditions, the optimum period for seed germination was June-July, indicating that high temperature and humidity were requisites for germination of *Asparagus racemosus.* The response of IAA, IBA and, GA_3 on *Melia azedarach* seeds was evaluatedand the growth regulators were effective in increasing seed germination. Among these GA_3 performed better than IAA, and IBA as reported by Banerjee[11]. Vijay and Kumar[3] reported that IBA favored maximum length of both root and shoot of the plant at 50 ppm concentration. NAA and GA_3 also favored the increase in plant height over control. GA_3 and IAA suppress the inhibitory action of ethylene when they act as a promoter. An interaction between endogenous and exogenous levels of hormones also might have play important role in plant growth. NAA at 10 ppm concentration influenced the root growth best. Pre-sowing seed treatments with growth substances such as gibberellic acid have been found to improve the seedling growth of many species[12,13]. In present study it was found that GA_3 was better than IAA, IBA, NAA inducing germination and root growth. Seed germination and seedling vigour as influenced by different concentration of GA_3 are presented in table 2. Treatment with high concentrations of GA_3 is effective in overcoming dormancy and causing rapid germination of seed. GA_3 with 50 ppm exhibited 70% germination, at 60 ppm 75 % germination was noted during day time and at the dark phase it was 87 % in 50ppm and 89 % in 60 ppm but as the concentration was increased there is a decrease in germination percent. The highest vigour index during light period was 820 in GA_3 and during dark period 850 in IBA. GA_3 (60 ppm) showed highest vigour index 840 during light period and 890 during dark period. Hormonal treatment with gibberellic acid accelerated seed germination.

Gibberellins are a family of 136 tetracyclic diterpenes, a small subset of which are active as plant hormones and known to stimulate seed germination in a wide range of plant species; the predominant active GA depends on the species[14]. Gibberellins stimulate germination by inducing hydrolytic enzymes that weaken the barrier tissues such as the endosperm or seed coat, inducing mobilization of seed storage reserves and stimulating expansion of the embryo[15]. GA_3 increased germination perentage of *Anemone coronaria* seeds at supra optimum (25ºC) but not at optimum temperature 10-20º C temperature[16]. Among the most countries, in Pakistan the productivity of wheat is limited, poor quality of seed and late sowing are of prime importance. Various seed invigouration treatments have been used to improve seed germination and seedling establishment. These include alternate hydration-dehydration[17], water soaking[18] and seed priming[19]. At higher concentration of GA_3 the germination percentage decreased. Propagation of plants from seed, although tedious, can facilitate the production of hybrid plants and enrich the genetical resources and diversity in breeding programme.

Conclusion

From the above data it may be concluded that growth hormones gave better response over control. Amongst all growth hormones, GA_3 gave best response for seed germination. GA_3 increases germination percent from 50 to 60 ppm but over 60 ppm concentration, germination decreases rapidly during light and dark period. IBA gives better response to root shoot length

than germination percent. The treatment of GA_3 was effective in breaking seed dormancy and reaching the germination rate and high vigour index.

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