Seed Germination and Viability Improvement in *Eryngium Foetidum* through Priming and Chemicals

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Abstract: Seed germination and field performance of *Eryngium foetidum* or Bilatidhonia using physical factors and chemical treatment was studied at the field laboratory of Bangabandhu Sheikh Mujibur Rahman Agricultural University during July 2012 to June 2013 to reduce seed cost increasing germination rate of Bilatidhonia. Experiment comprised with two factors viz. three seed treatment comprising growth regulator (GA_3 500ppm+Kinetin 50 ppm), pesticide (copper oxi-chloride 0.2% + tetracycline 1000 ppm) and control (distilled water) with six soaking levels viz. 0, 12, 24, 48, 72 and 96 hours soaking with 8 hours consecutive soaking and 4 hours drying. Treatment of seeds with growth regulator and priming of seeds enhanced seed germination in the field and laboratory. Consecutive 96 hours soaking and drying (8 hours soaking and 4 hours drying) of *Eryngium* seeds treated with GA_3 500 ppm and Kinetin 50 ppm gave the maximum germination percentage (74.7%) and enhanced germination (12.0 days). Chemicals (Tetracycline plus copper oxi-chloride) had no significant effect on germination compared to untreated seeds thus showed poor germination.

Key Words: Bilatidhonia, Germination, Manipulation, Physiology, Viability.

INTRODUCTION

Eryngium or Bilatidhonia (*Eryngium foetidium* L.) also known as Bangladhonia, Culantro, Cilantro, Shadobeni, feetweed, Eringo originated from Mexico and South America, Continental Tropical America, West Indies, Vietnam, Assam and Bangladesh (Nienga, 1995, Rashid, 1999, Rubatzky *et al*., 1999). It is a promising horticultural crop and falls under spices and condiments which seems a major cash crop in the hilly region of Bangladesh. This crop can also be grown well in the other parts of the country (Moniruzzaman, 2002). It is popular to the native consumers and recently remarkable extents are being exported to the UK and Middle East markets. Leaves and tender stems of *Eryngium* are used as spice, condiments and culinary herb. Medicinal values of these plants have also been reported. It is propagated mainly by seeds and a few cases by suckers. For commercial cultivation seeds are used as planting material. Asynchronized and un-uniform seed germination as well as very low germination rate (6-10%) are the major problems for popularizing its cultivation throughout the country (Mozumder *et al*., 2010). In addition to this, unavailability of adequate amount of seeds also limits the cultivation of *Eryngium*. On the other hand, all these criteria influence higher seed rate (40 kg/ha) of *Eryngium* which negatively affects the cost of cultivation (Moniruzzaman *et al*., 2002). To overcome such problems the germination rate should be increased. The use of GA_3 and kinetin for enhancing germination of coriander seed is well documented (Moraes *et al.* 1998; Naidu. 2001). In *Eryngium*, combined application of GA_3 (1000 ppm) and Kinetin (50 ppm) proved effective for enhancing seed germination up to 28.54% (Mozumder, 2009). Increased germination may be reduced seed rate which directly influences the cost of production. Moreover, more area can be cultivated with a limited amount of seed. But previously developed technology is not sufficient to increase seed germination near 100% inhibiting the negative effect of the germination by a chemical 'Coumarin' presents in *Eryngium* seeds (Ekpong, *et al*., 2008). Researches are required for complete removal of 'Coumarin' and increased germination percentage. The present experiment was designed with an emphasis to increase germination with application of growth regulators (GA_3 and Kinetin) with alternately seed soaking and drying lowering the coumarin level, increased α-amylase activities in seeds and to decrease seed rate to maintain an acceptable yield potentiality which will be cost effective in *Eryngium* cultivation. Therefore, the experiment was

conducted to increase the germination rate and to increase farmer's profitability decreasing the production (seed) cost in cultivating *Eryngium*.

METHODOLOGY

The experiment was conducted at the Horticulture Field Laboratory of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur during July 2012 to June 2013 to increase the germination rate of *Eryngium* seeds. The experiments comprised with two different factors such as growth regulator treatment and soaking duration. Germination test were conducted in normal room temperature with eighteen treatment combinations of two factors viz. three seed treatment comprising growth regulator (GA_3 500ppm + Kinetin 50 ppm) (Mozumder *et al*., 2011), pesticide (copper oxi-chloride 0.2% + tetracycline 1000 ppm) and control (distilled water) with six soaking levels viz. 0, 12, 24, 48, 72 and 96 hours soaking with 8 hours consecutive soaking and 4 hours drying was used in the experiments. Simultaneously 0, 1, 2, 4, 6, 8 times soaking and drying was performed for the aforesaid priming treatments, respectively. Growth regulator treatment combination of hormones GA_3 500 ppm and kinetin 50 ppm was previously proved better (Mozumder *et al*., 2011) which was prepared by mixing equal amount of GA_3 1000 ppm and kinetin 100 ppm aqueous solution. Chemicals (copper oxi-chloride 0.2% + tetracycline 1000 ppm) was also proven by previous experiment to control fungal and bacterial infestation during seed production (Mozumder *et al*., 2012). Seed are dried in shades after completion of priming for 30 minutes then soaked with different hormone solution and distilled water (control) for 15 minutes then air-dried in shade for 15 minutes. 100 seeds were placed on the wet blotting paper in each Petridis that treated as unit treatment and replicated three times. The seeds were covered with a thin layer of tissue paper to settle it's placement on the blotting paper and to prevent accumulation during watering. Data on days to germination, weekly germination rate and total germination was recorded up to 8 weeks and after that no germination was found. All the data were compiled properly and analyzed statistically by MS Excel, MSTAT-C Program and mean separation was done following the Duncan's Multiple Range Test (Zaman, *et al.* 1987).

RESULTS AND DISCUSSION

Seed treatment with growth regulator and chemicals (Tetracycline plus copper oxy-chloride) showed significant variation in respect to germination duration and weekly germination as well as total germination rate (Table 1& Fig. 1).

Effect of seed treatment

Early germination (15.1 days) was observed in growth regulator treatment while significantly delayed germination found in pesticide treatment (18.2 days) and control (17.2 days). Pesticide had no significant effect over control in respect to days to germination and germination percentage. During first three weeks PGR treated seeds gave the highest germination (31.9%) which was distinctly lower in control (9.0%) and pesticide treatment (7.1%). Similar trend was observed in second three weeks but no significant different was observed in third three weeks germination. The total germination percentage was highest (58.4%) in growth regulator treatment (GA_3 500 ppm and Kinetin 50 ppm). Significantly lower germination was found in control (23.2%) and pesticide treated seeds (17.6%). Moniruzzaman *et al*. (2000) obtained only 6-10% germination of Bilatodhonia (*Eryngium foetidum*) seeds without any treatment. The lowest germination from pesticide treated seeds seems that pesticide treatment had an adverse effect on germination in petridis. Applied pesticide might be hampered seed germination reducing α-Amylase activities during germination by osmotic competition or chemical reaction.

Table 1. Effect of chemical treatments on germination of *Eryngium* seeds

Chemical treatment (C)	Days to first germination	Germination %			
		1st 3 weeks	2nd 3 weeks	3rd 3 weeks	Total
Control	17.2a	9.0b	13.2b	1.0	23.2b
PGR	15.1b	31.9a	25.5a	1.0	58.4a
Pesticide	18.2a	7.1b	9.9b	0.7	17.6c
Significance	**	**	**	ns	**
CV%	5.15	10.74	21.28	40.9	10.89

PGR = Plant growth regulator (GA3+Kinetin); Pesticide (Copper oxy-chloride +Tetracycline)
Means followed by same letter or without letter in a column are not differed significantly at 5% level.
*, ** and ns indicates significant at 5%, 1% level and insignificant respectively

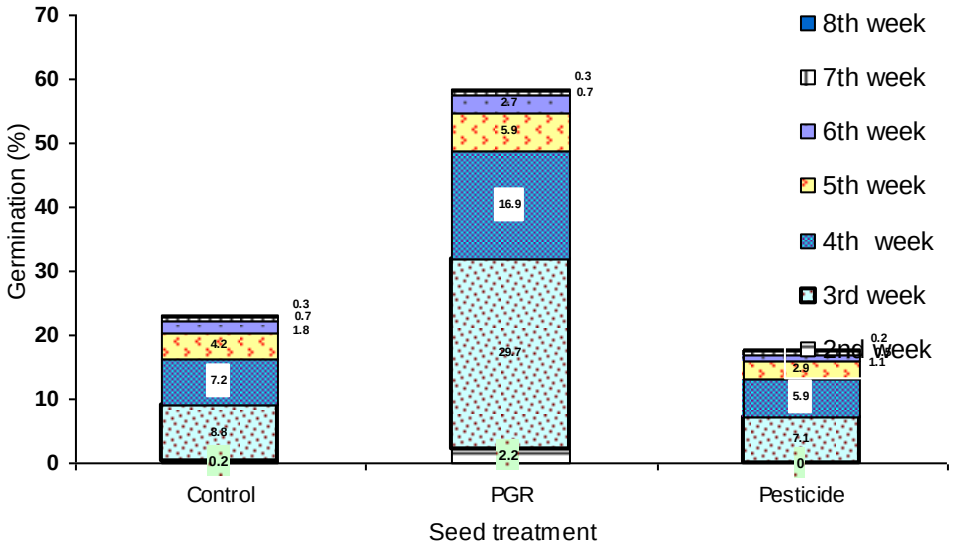

Fig.1. Weekly germination rate of *Eryngium* with different seed treatment

Figure 1. showed the weekly germination with different seed treatment. The major portions of seeds were germinated in third and fourth weeks then declined gradually and almost stopped after eighth week.

Effect of seed soaking

Consecutive soaking and drying of *Eryngium* seeds gave increased germination percentage and enhanced germination (Table 2 and fig. 2). Seeds germinated earlier (13.9 DAS) when soaked for longer period (96 hours) while it took longer time (19.8 DAS) in un-soaked condition. In first 3 weeks, significantly higher germination (29.3%) was recorded in long time soaked seeds then gradually decreased and was much lower in un-soaked control (4.2%). A moderate germination (12-19.5%) was observed in second three weeks. The reverse scenario was observed in third 3 weeks germination. Un-soaked control had the highest germination (2.9%) in 3rd three weeks and it was declined with increasing soaking duration and it was lowest in 96 hours soaking (0.1%). The declination of germination percent in 3rd three weeks with soaking because most of the viable seeds were germinated earlier but un-soaked seeds germinated slowly. The cumulative germination was also higher in 96 hours soaking. Consecutive soaking 8 hours and drying 4 hours of seeds for 96 hours (8 times) gave the early germination (13.9 days) and higher germination rate (46.0%) closely followed by 72 hours (6 times) soaking (43.6%). The lowest germination obtained from the un-soaked (control) treatment (20%).

Table 2. Effect of soaking duration on germination of *Eryngium* seeds

Soaking duration (D)	Days to first germination	Germination %			
		1st 3 weeks	2nd 3 weeks	3rd 3 weeks	Total
Control (D_1)	19.8a	4.2f	12.0b	2.9a	20.0d
12 hours (D_2)	18.6b	8.2e	14.4b	1.1b	23.7d
24 hours (D_3)	17.4c	13.0d	16.6ab	0.4c	30.0bc
48 hours (D_4)	16.3d	15.3c	17.1ab	0.4c	35.0b
72 hours (D_5)	14.9e	23.9b	19.5a	0.3c	43.6a
96 hours (D_6)	13.9f	29.3a	16.6ab	0.1c	46.0a
Significance	**	**	*	*	**
CV%	5.15	10.74	21.28	40.9	10.89

Means followed by same letter or without letter in a column are not differed significantly at 5% level.
* and ** indicates significant at 5%, 1% level, respectively.

The weekly germination clarified that the maximum *Eryngium* seeds germinated within 3-5 weeks but continued till 8th week in petridis (Fig.2). When seeds were soaked for 2 or more days the germination started earlier that three weeks. Un-soaked seeds took longer time for germination. The highest weekly germination (26.3%) was obtained in 3rd week from 96 hours soaked seeds. The higher germination in long time soaked seeds are due to maximum removal of germination inhibitor "Coumarin" and proper water uptake which is essential for seed germination.

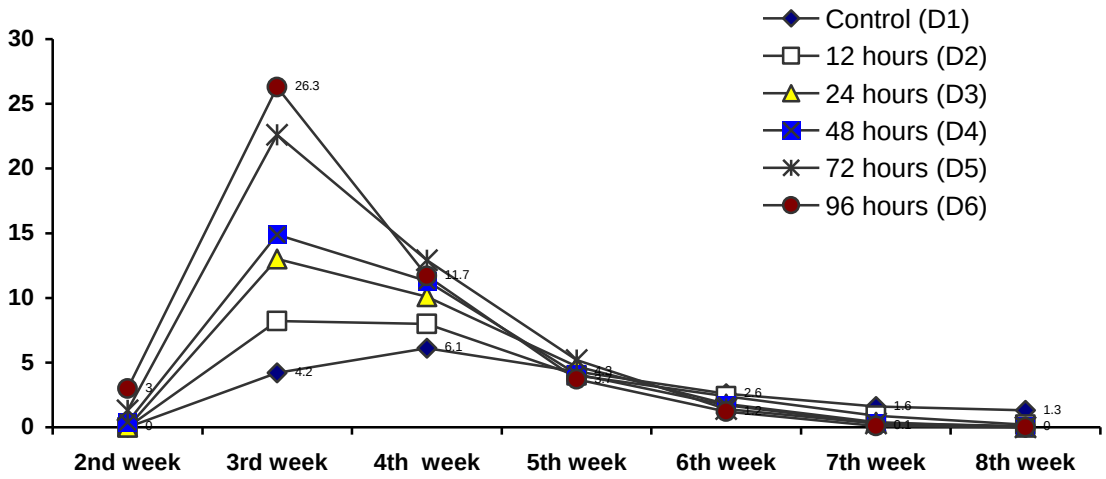

Fig. 2 Effect of soaking duration on weekly germination (%) of *Eryngium* seed.

The combined effect of chemical treatment and soaking

The combined effect of chemical treatment and soaking was significant in respect to weekly germination rate as well as total germination (Table 3). The maximum germination percentage (74.7%) and early germination (12 days) were obtained from the growth regulator treatment (GA_3 500 ppm and Kinetin 50 ppm) with 96 hours soaking (8 hours soaking and 4 hours drying for 8 times) closely followed by 72 hours soaking with same treatment. This result partially differed with the report of Ekpong *et al.,* (2008) who obtained the maximum germination at 72 days soaking. The lowest seed germination rate (9%) were obtained from the pesticide treated seeds with no soaking which was wonderfully lower than absolute control. This might be the cause of an adverse effect of pesticide in seed germination in *Eryngium*. Control (no soaking) with or without pesticide treatment showed the delayed (20.7 days) germination in petridis. Priming helps to initiate germination process supplying essential water and growth regulator enhanced α-amylase activities to breakdown starch to amino compounds. Amino compounds are essential to produce new cell organelles for cell division and enhanced growth of embryo (Mozumder, 2009). That is the cause that combination of priming and growth regulator enhances and increases the germination in *Eryngium*.

Table 3. Combined effect of chemicals and soaking duration on germination of *Eryngium* seeds

Treatments	Days to first germination	Weekly germination %							
		2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	Total
C_1D_1	20.7a	0.0c	2.0kl	2.7i	2.7	1.7	1.7	1.3	12.3hi
C_1D_2	18.7bc	0.0c	5.0ijk	4.3hi	2.7	1.0	0.7	0.3	14.0hi
C_1D_3	17.7de	0.0c	7.7ghi	6.0ghi	3.0	1.3	0.3	0.0	18.3gh
C_1D_4	16.7f	0.0c	9.3gh	7.7f-i	4.3	2.0	0.3	0.3	24.0fg
C_1D_5	15.3hi	0.0c	13.0ef	10.7d-g	6.3	2.7	0.7	0.0	33.3e
C_1D_6	14.3j	1.0c	16.0e	11.7def	6.0	2.0	0.3	0.0	37.0e
C_2D_1	18.0cd	0.0c	9.0gh	13.7cde	8.0	4.3	2.0	1.7	38.7e
C_2D_2	17.0ef	0.0c	16.0e	16.0a-d	7.0	5.0	1.3	0.3	45.7d
C_2D_3	15.7gh	0.0c	24.7d	19.0abc	8.0	2.7	0.3	0.0	54.7c
C_2D_4	14.7ij	1.3c	33.7c	19.7a	5.3	2.7	0.3	0.0	63.0b
C_2D_5	13.0k	4.0b	44.3b	19.3ab	5.7	1.0	0.0	0.0	73.7a

C_2D_6	12.0l	8.0a	50.3a	14.0b-e	1.7	0.7	0.0	0.0	74.7a
C_3D_1	20.7a	0.0c	1.7l	2.0i	2.3	1.7	1.0	1.0	9.0i
C_3D_2	20.0a	0.0c	3.7jkl	3.7hi	2.3	1.3	0.7	0.0	11.3hi
C_3D_3	19.0b	0.0c	6.7hij	5.3ghi	3.0	1.3	0.7	0.0	17.0gh
C_3D_4	17.7de	0.0c	7.7ghi	6.7f-i	2.7	0.3	0.3	0.0	18.0gh
C_3D_5	16.3fg	0.0c	10.3fg	8.7e-h	3.7	0.7	0.3	0.0	23.7fg
C_3D_6	15.3hi	0.0c	12.7f	9.3e-h	3.3	1.0	0.0	0.0	26.3f
Significance	*	ns	**	**	**	**	ns	**	**
CV%	5.15	105.62	10.87	28.08	35.94	47.28	80.90	120	10.89

Means followed by same letter or without letter in a column are not differed significantly at 5% level.
*, ** and ns indicates significant at 5%, 1% level and insgnificant respectively.

CONCLUSION

Growth regulator treatment (GA_3 500 ppm and kinetin 50 ppm) with 72 to 96 hours soaking (changing water at 8 hours intervals) gave the highest seed germination of *Eryngium* that reduced the about 75% seed rate as well as seed cost. Better germination ensured optimum number of plant per unit area resulted higher yield and economic return that increased profitability reducing the seed cost.

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