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Effect of pretreatments on seed dormancy and seedling vigour in Anjan grass (*Cenchrus ciliaris*)

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Abstract

Anjan grass (*Cenchrus ciliaris* L.) is native to tropical and sub-tropical Asia as well as Africa. It can be grown on wide range of soils and is a palatable and nutritious grass for grazing animals. Germination of freshly harvested seed of *Cenchrus* grass is very low due to dormancy. Present study was undertaken to determine the effect of various pre-soaking treatments on germination and seedling parameters of freshly harvested seed of Anjan grass. Pretreatments *viz.,* soaking in distilled water; KNO_3 (0.2, 0.4 & 0.6%); Thiourea (0.2, 0.4 & 0.6%) and GA_3 (100, 200 & 300 ppm) for 6, 12, 18 and 24 hours at 25°C in dark were applied to fresh seed for evaluating their effect on germination and vigour. Highest germination (44.8%) was recorded with GA_3 (200 ppm) soaking for 24 hours as compared to 12.8% in control and 18.0% in distilled water. All pretreatments showed significant increment in seedling length and dry weight compared to control. Seedling length of 11.9, 11.9 and 12.1cm were recorded with GA_3 (300 ppm) and KNO_3 (0.4%) soaking for 24 h, and Thiourea (0.6%) for 18 h respectively as compared to 10.0 cm in control and 10.7 cm in distilled water for 24 h. Highest seedling dry weight ranged from 5.4 to 5.8 mg/ 10 seedlings was observed with KNO_3 (0.6%), Thiourea (0.6%) and GA_3 (300 ppm) soaking as compared to control (3.4) and distilled water soaking (4.4 mg). Highest vigour index (534.3) was recorded in GA_3 (200 ppm) for 24 h soaking. Thus, pretreatment with GA_3 (200 ppm) for 24 h or GA_3 (300 ppm) for 18 h is effective for overcoming dormancy in the fresh seed of Anjan grass.

Keywords: *Cenchrus ciliaris*, Germination, Pretreatment, Seedling length, Vigour index

Anjan grass (*Cenchrus ciliaris* L.) is native to tropical, sub-tropical Asia and Africa. This can easily adopt and withstand tropical and sub tropical summer rainfall areas with long dry season. It can grow on wide range of soils varying from sandy to harder heavy textured soils with annual rainfall of 350- 800 mm and up to an altitude of 1000 m. The grass has ability to withstand heavy grazing and trampling by livestock.It contains high percentage of protein (8-10%). In this grass there is primary dormancy and physiological in nature. Germination of freshly harvested seed of *Cenchrus* grass is very low without any treatment (Sallum *et al*., 2010) but it increases after 6 month of harvesting up to 18 months. Germination (minimum) standard for foundation and certified seed in *Anjan* grass is 30% (Tunwar and Singh, 1988). Application of some physical, chemical and mechanical treatments to the seed are helpful in overcoming the dormancy. Therefore, the present study was undertaken to determine the effect of pretreatments (soaking) on germination and seedling parameters of fresh seed of *C. ciliaris*.

The study was undertaken during October 2014 at Western Regional Research Station of Indian Grassland and Fodder Research Institute, Avikanagar, Rajasthan. Standard package of practices required for raising a good crop were applied during seed production. Dormancy removal treatments were applied to one month old seed (spikelets) of *C. ciliaris* variety IGFRI-3108 harvested during September, 2014. The proportion of spikelets with seed (filled seed) was recorded as 62.7 % under soft X-ray scanning. Spikelets were exposed to pretreatments *viz*., soaking in distilled water; KNO_3 (0.2, 0.4 & 0.6%); Thiourea (0.2, 0.4 & 0.6) and GA_3 (100, 200 & 300 ppm) using 1:5 seed to solution (w/v) ratio to study their effects on dormancy removal. Spikelets without any pretreatment were taken as one control while soaking in distilled water is used another control. Spikelets in sufficient quantity were hydrated in aerated solution in each treatment. Soaked spikelets (seed) were put in the dark in the BOD incubator at 25°C for 6, 12, 18 and 24 hours. Then they were removed from solution and given three surface washings with distilled water, and dried under room condition to their original weight and used for germination. The experiment was conducted in CRD

design with four replications. 100 spikelets from each treatment for each replication were tested for germination using between paper method in the dark at 25°C for 10 days (ISTA, 2004). Number of normal seedlings were expressed as germination per cent. Five normal seedlings were randomly selected for observing seedling length and ten seedlings for dry weight. Vigour index was derived by multiplying germination per cent and seedling length.

Analysis of variance revealed that germination percentage increased significantly with pretreatment of all plant growth promoters under study over control as well as pretreatment with distilled water. Among the pretreatments GA_3 found most effective for enhancing germination. Pretreatment with GA_3 (200 ppm) for 24 h or GA_3 (300 ppm) for 18 h were equally effective. Highest germination (44.8 %) were recorded in pretreatment with GA_3 (200 ppm) for 24 hours as compared to 12.8 % in control and 18.0 % in distilled water. Significant interaction effect was observed for concentration of GA_3 and duration of pretreatment. Pretreatment effect of KNO_3 (0.6%) and Thiourea (0.4%) for 18 h gave 26.5% and 27.2% germination, respectively which was also significantly higher as compared to soaking in distilled water (16.5%) and control but significantly lower than GA_3 (100 ppm) for 12 h. In general higher concentration of growth promoters for 24 h showed negative effect on germination (Table 1). The increase in germination was attributed to build-up of germination enhancing metabolites (Basra *et. al.,* 2005). Pandeya and Jayan (1978) reported that 50 ppm GA_3 increased germinability in spikelets of all 11 ecotypes of *C. ciliaris* and higher concentrations had retarding effect in varying genotypes. Geeta (2010) observed that pretreatment of *C. glaucus* caryopses (dehusked seed) with $CuSO_4$ and ascorbic acid (25 ppm) for 16 h gave higher germination compared to other treatments. Qadir *et al.* (2011) reported that priming with 10 or 50 mM KNO_3 for 24 h improved germination in *C. ciliaris* compared to other pretreatments. Qian *et al*. (2006) reported that priming with KNO_3 enhanced germination in salt grass. The proportion of ungerminated spikelets decreased with the increase in germination per cent. Further evaluation of ungerminated spikelets either by X-ray scanning or manual dehusking may explain reason for non germination of the seed, it may be due to dormancy or empty seed.

All pretreatments under study showed significant increment for seedling length and seedling dry weight.

Table 1. Response of different seed soaking treatments on germination and seedling length in *C. ciliaris*

Treatment/	Germination %					Seedling length (cm)				
Duration	6 h	12 h	18 h	24 h	Mean	6 h	12 h	18 h	24 h	Mean
Distil water	13.0 (21.13)	14.7 (22.58)	16.5 (23.94)	18.0 (25.07)	(23.18) g	10.2	10.4	10.6	10.7	10.5 d
KNO_3 (0.2%)	13.0 (21.13)	16.0 (23.55)	18.0 (25.08)	19.2 (26.01)	(23.94) g	10.6	11.0	11.3	11.5	11.1 bc
KNO_3 (0.4%)	15.3 (22.99)	19.3 (26.02)	20.7 (27.09)	23.3 (28.82)	(26.23) f	10.8	11.2	11.7	11.9	11.4 abc
KNO_3 (0.6%)	18.7 (25.64)	22.5 (28.32)	26.5 (30.97)	23.8 (29.16)	(28.52) e	10.9	11.5	11.8	11.7	11.5 ab
Thiourea (0.2%)	14.3 (22.17)	18.7 (25.64)	22.5 (28.30)	27.2 (31.44)	(26.89) f	10.5	10.8	11.1	11.4	10.9 cd
Thiourea (0.4%)	16.8 (24.15)	22.0 (27.96)	27.2 (31.44)	29.5 (32.87)	(29.11) de	10.7	11.2	11.6	11.8	11.3 abc
Thiourea (0.6%)	21.2 (27.41)	25.5 (30.33)	27.5 (31.61)	26.7 (31.13)	(30.12) d	11.2	11.7	12.1	11.9	11.7 a
GA_3 (100 ppm)	27.2 (31.45)	32.0 (34.45)	35.8 (36.71)	38.5 (38.35)	(35.24) c	10.6	11.1	11.4	11.6	11.2 abc
GA_3 (200 ppm)	30.5 (33.52)	37.5 (37.76)	42.5 (40.63)	44.8 (41.99)	(38.47) ab	10.8	11.3	11.7	12.0	11.4 abc
GA_3 (300 ppm)	31.5 (34.14)	38.3 (38.20)	44.2 (41.67)	42.5 (40.69)	(38.67) a	11.4	11.7	11.9	11.7	11.7 a
Mean	(26.37) d	(29.48) c	(31.74) ab	(32.55) a		10.8 d	11.2 bc	11.5 ab	11.6 a	
CD at (1%)	Pretreatments (1.2); duration(0.8); interaction(2.4)					0.5 (pretreatments); 0.3 (duration); NS (interaction)				

Means sharing common letter in a column do not differ significantly at 1%; Values in parentheses are transformed arcsine values

Table 2. Response of different seed soaking treatments on seedling dry weight and vigour in *C. ciliaris*

Treatment/	Dry weight (mg/ 10 Seedlings)					Vigour index				
Duration	6 h	12 h	18 h	24 h	Mean	6 h	12 h	18 h	24 h	Mean
Distil water	3.6	4.1	4.4	4.5	4.1e	132.8	153.0	174.1	192.6	163.1f
KNO_3 (0.2%)	4.0	4.5	4.8	5.1	4.6c	137.9	177.1	203.9	222.4	185.3f
KNO_3 (0.4%)	4.4	5.0	5.4	5.6	5.1ab	163.8	215.5	242.9	276.3	224.6e
KNO_3 (0.6%)	4.8	5.3	5.8	5.7	5.4a	204.5	258.2	313.9	277.7	263.6d
Thiourea (0.2%)	3.9	4.4	4.8	5.0	4.5cd	149.8	202.4	250.4	309.9	228.1e
Thiourea (0.4%)	4.3	4.9	5.3	5.6	5.0b	179.6	246.6	316.1	349.1	272.8cd
Thiourea (0.6%)	4.5	5.0	5.4	5.2	5.0b	239.0	298.3	332.9	318.6	297.2c
GA_3 (100 ppm)	4.0	4.5	4.8	5.1	4.6c	288.9	354.3	407.3	446.3	374.2b
GA_3 (200 ppm)	4.2	4.7	5.1	5.3	4.8bc	327.6	421.3	496.2	534.3	444.8a
GA_3 (300 ppm)	4.5	5.0	5.4	5.3	5.0b	360.6	445.6	528.9	494.5	457.4a
Mean	4.2 c	4.7 b	5.1 a	5.2 a		218.4c	277.2b	326.6a	342.2a	
CD at (1%)	0.3 (pretreatments); 0.2 (duration); NS (interaction)					26.2 (pretreatments); 16.6 (duration); 52.4 (interaction)				

Means sharing common letter in a column do not differ significantly at 1 %

Seedling length was recorded 12.0 cm with GA_3 (200 ppm) at 24 h, 12.1 cm with Thiourea (0.6%) for 18 h and 11.9 cm with KNO_3 (0.4%) for 24 h which were equally effective as compared to 10.0 cm in control and 10.7 cm in distilled water for 24 h. Effect of pretreatment duration was non-significant between 24 and 18 h while, these both were significantly higher over 6 and 12 h (Table 1). Seedling dry weight also significantly increased with pretreatment of all growth promoters over control and with distilled water. Highest seedling dry weight ranged from 5.8 to 5.4 mg/10 seedlings was observed with pretreatment of KNO_3 (0.6%), Thiourea (0.6%) and GA_3 (300 ppm) for 18 h as compared to control (3.4) and with distilled water (4.4 mg/10 seedlings). Seedling dry weight increased by soaking up to 24 h significantly higher over soaking for 12 h but it was non-significant with soaking for 18 h. Non significant interaction effect between concentration and duration of pretreatment was observed for both seedling length and seedling dry weight (Table 1 & 2). Qadir *et al.* (2011) also reported that priming with 10 or 50 mM KNO_3 for 24 hours improved seedling growth in *C. ciliaris*. Nagar *et al.* (1998) reported significant increase in seedling length and dry weight with hydro-priming over control in maize genotypes under field condition.

Seed vigour is a sum of different seed attributes/ properties which determine the potential for rapid, uniform emergence and development of normal seedlings under a wide range of field conditions. Vigour index significantly increased with pretreatment of all growth promoters over control and soaking with distilled water. Among concentration of growth promoters, highest vigour index was recorded in 300 ppm GA_3 (457.4) and 200 ppm GA_3 (444.8) which were significantly higher compared to other treatments. In control and soaking in distilled water it was 127.3 and 163.1respectively (Table 2). Vigour index increased by soaking up to 24 h and was significantly higher over soaking for 12 h but it was non-significant with soaking for 18 h. Significant interaction effect between concentration and duration of pretreatment was observed for vigour index. Pretreatment with GA_3 (200 ppm) for 24 h or GA_3 (300 ppm) for 18 h is effective for overcoming dormancy in the fresh seed of Anjan grass.

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