

Nutrient Seed Coating Boosts Early Seedling Growth in *Cenchrus* Spp.

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Among the *Cenchrus* grass species, *Cenchrus ciliaris* (Anjan grass) and *C. setigerus* (Dhaman grass) are prominent perennial grass component of the *Dichanthium-Cenchrus-Lasiurus* grass cover of western India associated with arid and semi-arid regions of tropical and sub-tropical climate [1]. Once established, these grasses are very hardy that strives in arid and semi arid tropics and adapted in wide range of environments due to its drought tolerance, deep roots and rapid response to summer rains. These grasses have ability to withstand heavy grazing and trampling by livestock. Among different pasture grasses, these are considered palatable and nutritious grasses for all kinds of grazing animals. It also possesses, high biomass, resistance to overgrazing, high palatability and high nutritive value (protein 8-10% with 60-70% digestibility). After well establishment these grasses give 8-10 t/ha dry fodder out of 2-3 cuts in a year [2].

Rejuvenation and establishment of pasture in arid and semi-arid regions is difficult task due to uneven and poor stand, which limits to harvest potential forage production. The early seedling stage of *Cenchrus* grasses is very succulent and vulnerable to mortality due to lack of proper nutrition supply because mostly grasslands are poorly managed. Low germination and mortality of seedlings in early stage further aggravate the problem in ensuring uniform establishment of pasture.

Micronutrients also known as trace minerals are vital for plant growth and role of different micronutrients has well recognized in different crops. The absence of micronutrient fertilizers results in inadequate absorption of macro elements by plants, which causes lower fertilizer use efficiency, low activation of phytosiderophores and high infestation of various diseases. They often act as

co-factor in enzymes and participate in redox reactions, in addition to several other vital functions and play a key role such as protein synthesis, carbohydrate/ protein metabolism, photosynthesis, conversion of sugars to starch, auxin metabolism and resistance to infection by certain pathogens in plants [3]. Tabrizi *et al.* [4] studied effect of micronutrients *viz.* ZnSO₄, MnSO₄, H₃BO₃, FeSO₄ under three methods of application (soil application, seed coating and foliar application) on Maize and reported that applying any microelements in any methods increased net assimilation rate (NAR) and crop growth rate (CGR) of corn. Efforts has been made for supply of nutrients during early seedling stage through priming and pelleting which resulted boosting of grass seedlings under harsh field condition. Soil and foliar applications are the most prevalent methods of micronutrient application but the cost involved and difficulty in application are major concerns. Micronutrient application through seed treatments which include seed priming and seed coating enhance field establishment with good stand, advances phenological events, increases yield and micronutrient grain contents in most cases. Therefore, the present investigation was conducted for evaluating the effect of seed coating with macro and micro nutrients on early seedling growth parameters in *Cenchrus* species.

Seed treatments, which include seed priming and seed coating, are an attractive and easy alternative for application of nutrients in tiny quantity. In most cases, micronutrient application through seed treatment performed better or similar to soil and foliar application methods. Being an easy and cost effective method of micronutrient application, seed treatments offer an attractive option for resource poor farmers [5]. In the present investigation some micro and macro nutrients

were applied as seed coating for evaluating their effect on early seedling growth parameters. Spikelets of IGFR1-727 variety of Anjan grass and IG 96-593 promising genotype of Dhaman grass were used and experiment was laid out in the factorial complete randomised design under laboratory conditions. Spikelet filling was evaluated by manual dehusking and it was 67% in *C. ciliaris* and 75.3% in *C. setigerus*. The seed lots were 6 months old the time of experiment initiation. Nineteen treatment combination including three sources of micro and macro nutrients at three doses of each and one treatment was only jaggery treatment while in control no treatment was applied to spikelets. CuSO_4 , MnSO_4 , ZnSO_4 , KH_2PO_4 , KNO_3 were applied @ 5, 10 and 15 g/kg and DAP @ 30, 60 & 90 g/kg of spikelet (seed) in Anjan and Dhaman grass. Initially, different doses of all individual nutrients were evaluated separately and after identifying best dose of individual nutrient combination of macro and micro nutrients were also studied in separate experiment during 2016. Ten percent jaggery solution was used for adhering and uniform allocation of nutrients on spikelets. The coated spikelets were dried well under shade and kept in paper bags under ambient condition. The coated spikelets were used for evaluation for seedling growth parameters viz., germination percent, shoot length, root length and seedling dry weight at 0, 3 and 6 months after seed coating. The treated spikelets were evaluated for germination and seedling parameters in accordance with the methodology described as follows. Germination test: four replicates of 100 spikelets were used for each treatment and were distributed in paper towel rolls, moistened with water. The paper towel was wrapped in a butter paper to prevent water loss. Then, the rolls containing the spikelets were transferred to germination chamber at 25°C for 10 days in dark [6]. If more than one seedling emerged from one spikelet, only one seedling was considered for evaluation. Ten randomly selected normal seedlings were used for measuring seedling shoot and root lengths and these seedlings were transferred to paper bags and dried at 100°C for 24 h to obtain seedling dry weight.

The analysis of variance using factorial design for various seedling growth parameters revealed significant differences between control and different treatments in both the species. The use of jaggery alone solution was not differed from control (untreated spikelets). The differences for shoot and root lengths and seedling dry weight among the period of storage (0, 3 and 6 months)

were found nonsignificant in both the species, hence for describing the results mean data of 0, 3 and 6 months was used. Therefore, coated seed may be stored for six months under room condition without affecting the seed germination parameters.

Germination

The germination percentage was not affected significantly due to any macro/micro nutrient applying through seed coating in both the species. This result agrees closely with those reported by Rehman *et al.* [7], who stated that coating rice seeds with Zn had no effect on germination. Beutler *et al.* [8] evaluated effect of Zn in rice under different doses (0, 50, 100, 200, 400 and 800 g/ha), sources ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ and ZnCl_2) and mode of application (seed treatment and foliar spray). They reported that seed treatment with Zn did not change germination or seedling emergence. Tavares *et al.* [9] also did not observe any differences in rice seed germination following treatment with different doses of formulated products containing Zn.

Shoot Length

Fast seedling emergence is important, as it allows for rapid establishment of field plants and reduces interference by weeds. The increased competitive ability of plants is associated with early emergence [10]. Plants with a high emergence speed and early growth take priority over environmental resource use and generally have an advantage [11]. In the present study in *C. ciliaris*, longest shoot length was observed with application of DAP 60g (11.1 cm) followed by KH_2PO_4 15g, KNO_3 10g and ZnSO_4 10g which shows significant difference as compared to control. Similar observations were also recorded in *C. setigerus* for shoot length (Table 1). Out of combination of macro and micro nutrients in *C. ciliaris* longest shoot length was observed with application of ZnSO_4 10g + DAP 60g (11.2 cm) and with similar effect of DAP 60g (11.1 cm), ZnSO_4 10g (11 cm), CuSO_4 10g + DAP 60g and MnSO_4 10g (10.3 cm). While, in *C. setigerus* longest shoot length was observed by application of ZnSO_4 10g + DAP 60g (10.8 cm) and was at par with DAP 60g (10.5 cm), ZnSO_4 10g and CuSO_4 10g + DAP 60g (10.3 cm), MnSO_4 10g (10.1 cm) (Table 2).

Root Length

In general, it is found that micro nutrients are more important for enhancing root length which will be helpful

Table 1. Evaluation of nutrient coating treatments for seed quality parameters in *Cenchrus* species

Treatment	<i>Cenchrus ciliaris</i>				<i>Cenchrus setigerus</i>			
	Germination %	Shoot length (cm)	Root length (cm)	Seedling dry weight (mg)	Germination %	Shoot length (cm)	Root length (cm)	Seedling dry weight (mg)
Control	34.3	9.3	2.5	0.46	33.3	9.5	2.8	0.40
Jaggery	35.2	9.6	2.4	0.51	33.8	9.7	3.1	0.47
CuSO ₄ 5g	35.9	9.7	2.6	0.55	33.7	9.1	3.3	0.51
CuSO ₄ 10g	36.0	9.7	2.8	0.59	34.7	9.5	3.5	0.53
CuSO ₄ 15g	35.0	9.8	2.7	0.55	35.3	9.9	3.6	0.54
MnSO ₄ 5g	34.8	9.3	2.7	0.55	34.4	9.1	3.4	0.52
MnSO ₄ 10g	35.1	9.6	2.7	0.61	35.3	9.6	3.5	0.53
MnSO ₄ 15g	33.7	9.8	2.9	0.57	33.8	9.3	3.3	0.51
ZnSO ₄ 5g	33.8	9.4	2.7	0.60	35.1	9.4	3.5	0.53
ZnSO ₄ 10g	35.1	10.5	2.9	0.66	33.8	10.4	3.6	0.56
ZnSO ₄ 15g	34.3	9.6	3.1	0.59	34.3	9.7	3.4	0.55
KH ₂ PO ₄ 5g	30.8	10.4	2.2	0.52	31.0	9.9	2.8	0.51
KH ₂ PO ₄ 10g	33.8	10.8	2.6	0.56	33.5	10.3	3.1	0.53
KH ₂ PO ₄ 15g	32.6	11.0	2.3	0.52	33.1	10.6	3.3	0.49
KNO ₃ 5g	31.4	10.2	2.2	0.51	33.5	10.2	2.8	0.44
KNO ₃ 10g	33.9	10.5	2.6	0.50	34.4	9.9	3.2	0.48
KNO ₃ 15g	33.2	10.2	2.4	0.46	34.1	9.7	3.0	0.46
DAP 30g	30.6	11.0	2.5	0.50	30.1	10.6	2.7	0.46
DAP 60g	33.7	11.1	2.7	0.53	32.9	10.4	3.3	0.49
DAP 90g	30.9	10.8	2.6	0.50	30.0	10.1	3.0	0.47
Mean	33.9	10.1	2.6	0.54	33.5	9.8	3.2	0.50
CD (p= 0.05)								
Nutrients	NS	0.6	0.2	0.05	NS	0.6	0.2	0.04
Storage period	NS	NS	NS	NS	NS	NS	NS	NS
Nutrients x Storage period	NS	NS	NS	NS	NS	NS	NS	NS

for combating moisture stress during early seedling stage. Longest root length in *C. ciliaris* was observed with ZnSO₄ 10g (3.1 cm) and with equal effect of ZnSO₄ 15 g and MnSO₄ 15g (2.9 cm), while in *C. setigerus* longest root length was observed with ZnSO₄ 10g and CuSO₄ 15g (3.6 cm) followed by ZnSO₄ 5g, CuSO₄ 10g, MnSO₄ 10g (3.5 cm) (Table 1). The combined effect of CuSO₄ 10g + DAP 60g (3.2 cm) and ZnSO₄ 10g + DAP 60g (3.1 cm), on root length was found similar with significant increase over control in both the species (Table 2).

Seedling Dry Weight

Highest seedling dry weight was accumulated by application of ZnSO₄ 10g (0.66 mg/seedling) and MnSO₄ 10g (0.61 mg) in *C. ciliaris*. While, in *C. setigerus* seedling dry weight enhanced at par with use of ZnSO₄ 10g (0.56 mg), CuSO₄ 15g (0.54 mg), MnSO₄ 10g, and KH₂PO₄ 10g (0.53 mg) with significant difference as compared to control (Table 1). In *C. ciliaris*, highest seedling dry weight was recorded with the combination of CuSO₄ 10g

+ DAP 60g (0.62 mg) followed by ZnSO₄ 10g + DAP 60g (0.60 mg), while in *C. setigerus* highest seedling dry weight was observed in ZnSO₄ 10g + DAP 60g (0.55 mg) followed by CuSO₄ 10g + DAP 60g (0.53 mg) (Table 2). Hence, for enhancing seedling dry weight combination of macro and micro nutrients were helpful. Wiatrak [12] observed that seed treatment with polymer based mixture of Copper, Manganese and Zinc micronutrients at 265, 395 and 530 mL/ 100 kg seeds increased biomass (dry matter) production by 13.4, 22.6 and 20.7% in dryland winter wheat over control. Beutler *et al.* [8] reported that seedling dry mass and germination at low temperatures (cold test) enhanced by using ZnSO₄.7H₂O.

Application of ZnSO₄, MnSO₄ and CuSO₄ (@10 g/kg seed) were equally effective for enhancing root length and seedling dry weight as well. While, application of DAP 60 g, KH₂PO₄ 15 g and KNO₃ 10 g/kg seed were equally effective for enhancing shoot length significantly over control. Hence, combination of macro and micro-nutrients *viz.*, ZnSO₄ 10 g + DAP 60 g/kg seed or CuSO₄ 10 g + DAP 60 g/kg seed was effective for enhancing

Table 2. Effect of identified treatments on seed quality parameters in *Cenchrus* species

Treatment	<i>Cenchrus ciliaris</i>				<i>Cenchrus setigerus</i>			
	Germination %	Shoot length (cm)	Root length (cm)	Seedling dry weight (mg)	Germination %	Shoot length (cm)	Root length (cm)	Seedling dry weight (mg)
Control	29.5	9.7	2.4	0.46	31.0	9.6	3.0	0.46
Jaggery	31.0	9.9	2.6	0.47	32.8	9.6	3.0	0.47
CuSO ₄ 10g	32.5	10.0	2.9	0.57	35.0	9.9	3.4	0.54
MnSO ₄ 10g	32.3	10.3	2.8	0.53	33.5	10.1	3.3	0.50
ZnSO ₄ 10g	34.5	11.0	2.9	0.57	35.5	10.3	3.3	0.55
DAP 60g	34.8	11.1	3.0	0.59	34.8	10.5	3.3	0.52
CuSO ₄ 10g + DAP 60g	34.0	10.3	3.2	0.62	36.0	10.3	3.6	0.53
MnSO ₄ 10g + DAP 60g	32.0	10.2	2.7	0.54	33.5	9.9	3.3	0.49
ZnSO ₄ 10g + DAP 60g	35.8	11.2	3.1	0.60	36.8	10.8	3.5	0.55
Mean	32.9	10.4	2.8	0.55	34.3	10.1	3.3	0.51
CD (p=0.05)	NS	1.0	0.5	0.07	3.4	0.8	0.3	0.06

shoot and root length and seedling dry weight as well. The coated seed may be stored for six months under room condition without affecting the seed germination parameters.

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