



Effect of pelleting material on seedling emergence and growth parameters in *Cenchrus* species

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Abstract

Seeds of *Cenchrus* grasses are chaffy and light in weight, so sowing of sole grass seed at proper depth and spacing is a great challenge. Seed yield of grasses are very low, while demand for seed is high for rejuvenation of grasslands. Seed pelleting could play important role in utilization of seed efficiently and in uniform establishment of grassland. Around 20 mm diameter handmade pellets of different materials viz., farm soil, clay, farm yard manure, sawdust and cocopit and their combinations were evaluated for seedling emergence, growth and wilting in *Cenchrus ciliaris* and *C. setigerus*. Effect of pelleting materials was found non-significant on seedling emergence in both species but significant difference was observed for seedling dry weight and wilting of seedlings. Lowest wilting (48.9%) was recorded in Soil+Clay+FYM in 2:1:1 ratio and highest wilting (78.1%) was observed in pellets of clay alone. Application of katira gum was not found beneficial for delaying of wilting, instead higher doses of katira gum increased the wilting proportion. *C. ciliaris* had better moisture stress tolerance than *C. setigerus* as indicated by less percentage of wilted seedlings.

Keywords: Grass seeds, Katira gum, Pelleting, Seedling emergence, Spikelet, Wilting

Cenchrus species are the prominent range grasses of arid and semi-arid regions (Dabadghao and Shankarnarayan, 1973). Among different pasture grasses, these are considered palatable and nutritious for all kinds of grazing animals (Sawal *et al.*, 2009). These grasses have ability to withstand heavy grazing and trampling by livestock. Rejuvenation and development of pasture in arid and semi-arid regions is difficult task due to uneven and poor plant stand which resulted in low productivity of the grasslands. Uncertainty in presence of viable seed in the spikelet due to indeterminate seed maturity resulted in continuous seed shattering and light weight of the seed, create difficulties for raising uniform

pasture (Parihar, 2010). Roy and Singh (2013) highlighted that degradation of pasturelands due to overgrazing coupled with poor management led to deterioration to a large extent and needs rejuvenation for sustainable livelihood. Seed (spikelets) of these grasses is chaffy and light in weight so sowing of sole seed at proper depth and spacing is difficult task. Low germination and mortality of seedlings in early stages further aggravate the problem in establishing uniform pasture. Seed yield of grasses are very low while demand for seed is high for rejuvenation of grasslands. Seed pelleting could play important role in utilization of seed efficiently and in uniform establishment of grassland. Seed pelleting is a technique of seed encapsulation with organic, inorganic nutrient, water absorbent, pesticides and it provides an opportunity to package effective quantities of materials in such way that they can influence the seed or soil at the seed-soil interface (Geetha and Balamurugan, 2011). Dowling (1978) reported that establishment of grass was significantly improved during warmer months with seed coating in New South Wales. Cook and Dolby (1981) also observed that pelleting increased establishment in *C. ciliaris*. There are many substances that have higher water holding capacity. Combination of such materials for seed pelleting is expected to help in slow release of moisture during the moisture stress condition ensuring seedling growth (Lather *et al.*, 2015). Application of micronutrients in pellets or use of pretreated seeds with micronutrients will be helpful in germination and boosting the early seedling growth for better establishment (Geetha and Balamurugan, 2011; Nagar and Meena, 2015; 2018). Therefore, the present study was undertaken to record the effect of combination of different pelleting materials on seedling emergence and growth parameters of *Cenchrus* species.

Different pelleting materials viz., farm soil (loamy sand having clay-10.4%, silt-5.6% and sand-84.0%), clay (pond soil), farm yard manure (FYM), sawdust and cocopit and their combinations were used for pelleting. Required

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quantity of water was added to make the pelleting materials in dough stage. Clay was used as binding agent and for increasing water holding capacity of pellets. FYM, sawdust, cocopit were used in pelleting for good aeration and supply of nutrients to emerging seedling. Six month old seed (spikelets) of *C. ciliaris* (IGFRI-3108) and *C. setigerus* (IG 96-593) were used for pelleting. Seed of these species vary in test weight, hence 8 g of *C. ciliaris* and 12 g of *C. setigerus* seed/kg pelleting material was mixed uniformly for pellet formation. Germination of seed lot used for pelleting was 38-42%. Pellets of spherical shape of around 20 mm diameter were prepared manually and dried in shade. Weight of one pellet ranged from 5 to 7 g which embedded 10 to 12 seeds.

Gum katira (natural gum obtained from *Astragalus* species) as seed coating helps in reducing irrigation frequency due to its hydrophilic nature (Lather *et al.*, 2015). Therefore, in second experiment three doses of katira gum 2.5, 5.0 and 7.5% of seed weight basis were used as seed coating and other three doses 0.5, 1.0 and 1.5% of pelleting material weight basis were mixed in pelleting materials *i.e.* Soil+Clay+FYM in 2:1:1 ratio to study the effect of gum katira on emergence and growth parameters of seedlings.

Pellets were evaluated in pots in complete randomized design with 3 replications during 2017. In each pot 10 pellets were placed and watering was done up to soil saturation on first and fourth day of sowing for maintaining soil moisture for germination and afterward no watering was done up to 20 days to create water stress condition. Observation on seedling emergence from each pellet in a pot was recorded from 3 days after sowing (DAS) up to 20 DAS. Emergence of seedling in all pellets was recorded in each pot and expressed as number of seedling/pellet. Plant height was recorded on 10 randomly selected seedlings across the pellets within a pot and same seedlings were used for recording shoot dry weight after drying in hot air oven at 75 °C for 24 hours. Due to 20 days gap of watering, wilting of seedlings was visualized. On 24 DAS water was applied to all pots up to soil saturation for revival of seedlings. After 24 hours of watering, again number of revived and permanent wilted seedlings in each pot was recorded and proportion of permanent wilted seedling was calculated. Range of temperature and relative humidity during first experiment was 31-34 °C and 54-71%, and during second experiment was 30-38 °C and 51-79%, respectively.

Seedling emergence was initiated from 3rd day and completed at 10 DAS in all pellet types. Number of seedlings/pellet did not differ significantly (Table 1) among the pellets except pellets of clay alone in both the species which ranged from 4.4 to 5.3 and 4.7 to 5.4 in *C. ciliaris* and *C. setigerus*, respectively. Seedling dry weight differed significantly due to composition of pellets, while seedling height did not differ in both species. Pellets of clay alone were not found suitable for emergence indicated by significantly less seedling emergence/pellet coupled with higher wilting percentage. Sachs *et al.* (1981) reported that clay alone as pelleting material could restrict the gas exchange because of very fine particle size. Pellets of mixture of soil, clay and FYM in both 2:1:1 and 3:1:1 ratio exhibited similar effect on seedling emergence and growth parameters. Darrag and Kareem (1994) also reported improved germination of grass seeds in pellets of clay and silt in 3:1 ratio.

Use of saw dust and cocopit as pelleting material in any ratio mixed with soil, clay and FYM did not enhance emergence and seedling growth parameters. Maity *et al.* (2017) also reported that soil is best pelleting material for dinanath grass and further emphasized that layered pelleting in which seed is confined in upper layer only increased germination and reduced seedling mortality. Kumar (2003) also reported that pellets of clay and silt in 3:1 ratio along with organic manure improved emergence and crop performance of *C. setigerus* grass. Abusuwar and Eldin (2013) reported that pelleting with FYM performed well in terms of plant density and number of leaves. In contrary of present findings Yadav *et al.* (2000) reported 100% germination in *C. ciliaris* in pellets of clay (tank silt) alone followed by pellets of tank silt+oil cake (86.7%) which might be due to small pellet size (4 mm) as compared to 20 mm in present study. Higher number of seeds per pellet would be able to emerge from crust of clay pellet due to collective force of seedlings but due to competition among the seedlings might result in low survival. Lowest wilting (48.9%) was recorded in pellets of Soil+Clay+FYM in 2:1:1 ratio, while it was highest (78.1%) in pellets of clay alone in both the species. Hence, high proportion of clay is not desirable in pelleting specially when there are chances of moisture stress. If soil has sufficient clay content, mixing additional clay may be avoided. However, seed rates need to be adjusted for ensuring germination of 4-5 seedling/pellet for developing good tussock. Bunch of 4-5 seeds in pellet also help in seedling emergence due to agglomeration effect. Madsen *et al.* (2012) observed that in clay soil, seedling emergence from the agglomeration treatment was 1.3-1.9 times higher than the single seed.

Table 1. Effect of pelleting materials on seedling emergence and seedling growth in *Cenchrus* species

Treatment	<i>Cenchrus ciliaris</i>				<i>Cenchrus setigerus</i>			
	No. of seedling /pellet	Seedling height (cm)	Seedling dry weight (mg)	Wilted seedling (%)	No. of seedling /pellet	Seedling height (cm)	Seedling dry weight (mg)	Wilted seedling (%)
Soil+Clay+FYM (2:1:1)	4.9	9.2	1.8	48.9	5.0	10.3	1.9	49.5
Soil+Clay+FYM (3:1:1)	5.0	9.2	1.5	56.0	5.2	9.9	1.6	58.8
Soil+Clay+FYM+ Saw dust (12:3:3:2)	5.2	9.9	2.1	49.0	5.3	10.6	2.2	50.0
Soil+Clay+FYM+ Saw dust (12:3:4:1)	5.2	9.0	1.7	53.0	5.3	10.2	1.8	53.4
Soil+Clay+FYM+ Saw dust (12:4:3:1)	5.1	9.7	1.8	55.0	5.1	10.7	1.8	54.9
Soil+Clay+FYM+ Saw dust (14:3:1:2)	5.2	9.3	1.7	61.5	5.3	10.3	1.9	62.4
Soil+Clay+FYM+ Saw dust (14:3:2:1)	5.2	8.7	1.2	69.7	5.2	10.1	1.7	71.1
Soil+Clay+FYM+ Cocopit (12:3:3:2)	5.3	8.7	1.2	54.3	5.3	10.3	1.5	56.0
Soil+Clay+FYM+ Cocopit (12:3:4:1)	5.1	8.7	1.3	58.8	5.2	10.2	1.4	59.6
Soil+Clay+FYM+ Cocopit (12:4:3:1)	5.2	8.6	1.3	61.5	5.2	9.7	1.4	64.1
Soil+Clay+FYM+ Cocopit (14:3:1:2)	5.3	8.4	1.5	69.8	5.4	9.5	1.5	72.1
Soil+Clay+FYM+ Cocopit (14:3:2:1)	5.3	8.5	1.2	72.3	5.3	10.1	1.6	73.5
Clay only	4.4	7.5	1.3	78.1	4.7	9.3	1.7	79.5
Soil only	5.3	9.5	1.9	62.5	5.4	10.3	2.0	64.9
Mean	5.1	8.9	1.5	60.8	5.2	10.1	1.7	62.1
SEM $\pm$	0.2	0.5	0.1	5.5	0.2	0.3	0.1	5.8
CD (P=0.05)	NS	NS	0.3	16.0	NS	NS	0.4	16.8

In the second experiment, application of gum katira as seed coating and by mixing in pelleting material did not show any beneficial effects (Table 2) over pellets of Soil+Clay+FYM in 2:1:1 ratio (one of the better combination of pelleting in the first experiment and used as control in this experiment) for any of parameter. Application of gum katira @ 2.5% and 5.0% (seed weight basis) and 0.5% (soil weight basis) were at par with control, while, higher doses of katira gum reduced seedling emergence significantly over control in both *C. ciliaris* and *C. setigerus*. Effect of katira gum on seedling height and seedling dry weight was also found non-significant over control. Lowest proportion of permanent wilted seedling was recorded in control (42.3% in *C. ciliaris* and 42.7% in *C. setigerus*) and any doses of katira gum in both the application methods was not found beneficial in decrease of wilting over control, while higher

doses increased proportion of wilted seedling. In contrast of the present findings, Lather *et al.* (2015) reported that wheat seed coated with katira gel @ 10% of seed weight, were effective in mitigation of suboptimal moisture stresses with improved seed germination, seedling survival, plant growth, water use efficiency under limited irrigation. Patil *et al.* (2014) also reported that application of Pusa hydrogel helped in conserving soil moisture in root zone, plants to withstand extended moisture stress, delayed onset of permanent wilting point in wheat.

Spherical pellets (~20 mm diameter) of soil, clay and FYM in 2:1:1 ratio had overall better performance for seedling emergence and growth parameters. Such materials used for pelleting are also locally available and cost effective, therefore, this combination may be used for pelleting of *Cenchrus* grass seeds.

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Table 2. Effect of gum katira on germination and seedling growth in *Cenchrus* species

Treatment	<i>Cenchrus ciliaris</i>				<i>Cenchrus setigerus</i>			
	No. of seedling /pellet	Seedling height (cm)	Seedling dry weight (mg)	Wilted seedling (%)	No. of seedling /pellet	Seedling height (cm)	Seedling dry weight (mg)	Wilted seedling (%)
Soil+Clay+FYM (2:1:1)-Control (C)	4.8	9.7	1.7	42.3	4.9	10.8	1.9	42.7
C + Katira gum 2.5% (seed wt. basis)	4.8	9.6	1.6	43.5	4.7	11.0	1.8	47.6
C + Katira gum 5.0% (seed wt. basis)	4.5	9.6	1.6	56.3	4.5	10.8	1.7	59.0
C + Katira gum 7.5% (seed wt. basis)	4.3	8.8	1.5	69.0	4.2	10.4	1.6	73.7
C + Katira gum 0.5% (soil wt. basis)	4.5	9.5	1.6	46.4	4.4	10.8	1.7	49.6
C + Katira gum 1.0% (soil wt. basis)	4.1	9.1	1.4	59.4	4.1	10.5	1.6	62.4
C + Katira gum 1.5% (soil wt. basis)	4.0	8.6	1.4	70.7	4.0	10.1	1.6	74.3
Mean	4.4	9.3	1.5	55.4	4.4	10.6	1.7	58.5
SEM ±	0.1	0.4	0.1	5.3	0.2	0.5	0.1	6.6
CD (P=0.05)	0.4	NS	NS	16.1	0.5	NS	NS	20.1

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