Range Management and Agroforestry 45 (2) : 357-360, 2024
ISSN 0971-2070 (Print); 2249-5231 (Online)
https://doi.org/10.59515/rma.2024.v45.i2.23

Short communication

Field establishment of *Cenchrus* grass pasture through seed pelleting

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Received: 18th August, 2023 Accepted: 25th July, 2024

Abstract

Sowing the individual seeds of grasses at proper depth and spacing is a great challenge. Low germination and high seedling mortality at an early stage is a general problem in the establishment of pasture. Spikelets (seed) of *Cenchrus ciliaris* were used for the formation of seed pellets *viz.* round shaped and cube-shaped and cloth pouch. Pelleting materials consisted of farm soil, clay and farm yard manure in a 2:1:1 ratio. The weight of one pellet ranged from 5 to 7 g which embedded 8-10 spikelets. Two sowing methods *viz*. dry sowing and normal sowing, were evaluated. Significant differences were observed in germination and other growth parameters for both sowing methods and types of pellets. The number of seedlings/pellet in dry sowing ranged from 2.5-4.5, while in normal sowing it ranged from 3.8-5.5. The highest plant stand per plot was recorded in cloth pouch (84.5) followed by cube-shaped pellet (75.7) and round-shaped pellet (71.1). Seedling mortality was high in the dry sowing method, irrespective of the type of pellets. Cloth pouches had an advantage over both types of pellets for plant stands, while cube-shaped pellets were found to be better when compared to round-shaped pellets.

Keywords: *Cenchrus ciliaris*, Germination, Grassland, Pasture rejuvenation, Seed pelleting

Cenchrus grass species are the prominent range grasses of arid and semi-arid regions. Among different pasture grasses, these are considered highly palatable and nutritious for all types of grazing animals. These grasses also have an immense ability to withstand heavy grazing and trampling by livestock. Rejuvenation and development of pastures in these regions is a challenging task due to uneven and poor plant stand, which limits the potential fodder production (Shinde and Mahanta, 2020; Chandra *et al*., 2022). Roy and Singh (2013) highlighted that the degradation of pastures due to overgrazing coupled with poor management led to deterioration to a large extent in grasslands of arid and semi-arid regions of the country and needs rejuvenation for sustainable livelihoods. The seed production of these grasses is very low due to the lightweight, small seed size, seed shattering, and indeterminate seed maturity (Parihar, 2010), while demand for seed is high for the rejuvenation of degraded grasslands. Seed production of *Cenchrus* grass is undertaken during the monsoon season. Climatic factors like rainfall, temperature, humidity, *etc*., influence seed setting. Continuous rains during flowering, seed development, and maturation stages adversely affect the seed yield as well as its quality (Nagar and Meena, 2021). Sowing of sole grass seed at proper depth and spacing is a great challenge. Low germination and high mortality of seedlings at an early stage further aggravate the problem in the establishment of uniform pasture. The grass seedling is very delicate, slow, and sensitive to moisture stress during early seedling growth. Seed pelleting could play an important role in the utilization of grass seed efficiently and in the uniform establishment of grasslands. Seed pelleting is a technique of seed encapsulation with organic and inorganic nutrients, water absorbents, pesticides, *etc*., which provides an opportunity to package effective quantities of materials in such a way that they can influence the seed and soil at the seed-soil interface (Geetha and Balamurgan, 2011). Madsen *et al.* (2012) observed that in clay soil, seedling emergence from the agglomeration effect was about doubled than the single seed. The application of micronutrients in pellets or the use of primed seeds with micronutrients will also be helpful in enhancing germination and boosting the early seedling growth for better establishment of pasture

(Nagar and Meena, 2015; Nagar *et al*., 2018). Meena and Nagar (2019) reported that pellets of around 20 mm diameter made of soil (loamy sand), clay (pond soil) and farm yard manure in a 2:1:1 ratio were found effective for enhancing seedling dry weight and reducing seedling mortality significantly. Kumar (2003) also reported that pelleting of clay and silt in 3:1 ratio along with organic manure improved the emergence and crop performance of *C. setigerus* grass. Maity *et al*. (2017) also reported that soil is the best pelleting material for Dinanath grass and reduced seedling mortality. Therefore, the present study was undertaken to record the effect of the type of pellets and sowing time on the field establishment of *Cenchrus* grass pasture.

Seed of *Cenchrus ciliaris* (var. IGFRI-3108) was used for the formation of three types of seed pellets *viz*. round-shaped and cube-shaped and cloth pouch. Pelleting materials *viz*. farm soil (loamy sand having 10.4% clay, 5.6% silt and 84.0% sand), clay (pond soil) and farm yard manure were used in 2:1:1 ratio for making pellets. Indeed, farm soil was used as base material, while clay and farm yard manure were used for enhancing moisture retention capacity, aeration and nutrition of seedlings. The approximate weight of one pellet ranged from 5 to 7 g, which embedded 8 to 10 seeds (spikelets). The average diameter of the round-shaped pellet and the size of the cube ranged from 20 to 25 mm. An appropriate quantity of water was added for making pelleting material in the dough stage. Round pellets were made by hand, while cubes were made with the use of a metal frame. Small pouches of muslin cloth (40 x 40 sq. mm) were made by stitching and filled with the same quantity of pelleting material (Fig 1). Muslin/malmal cloth was very thin, delicate, feather-light and breathable cloth made of cotton.

The seed pellets were evaluated in the field at the Research Farm of Western Regional Research Station, ICAR-IGFRI, Avikanagar, for three years (2018-20) during the kharif season. The area is situated at 27°17′ N latitude and 75°22′ E longitude in the semi-arid region with annual rainfall of 560 mm received mainly during the southwest monsoon. The soil of the experimental farm was loamy sand with pH above 8.0. The soil was low in organic matter content (0.25%), having available nitrogen- 162.2 kg/ha, available phosphorus- 15.01 kg/ha and available potash- 238.7 kg/ha. The field experiments were laid out in factorial RBD with four replications. Two sowing methods were used for the establishment of pasture *viz*., dry sowing (sowing before the onset of monsoon rains, last week of June) and normal sowing (sowing after receiving 1 to 2 effective rains (mid of July). In dry sowing, pellets were placed on the surface of the soil without any plowing after proper bush/weed cleaning of the field. While in normal sowing, pellets were placed on the soil after proper soil preparation (plowing and planking at proper soil moisture). One hundred pellets were placed in a plot size of 15 square meters for each treatment per replication. During the field experiment, rainfall received (from 25th June to 2nd September) in 2018 was 215.4 mm with 23 rainy days; it was 467.3 mm with 32 rainy days in 2019 and it was 358.1 mm with 34 rainy days in 2020. The emergence of seedlings in ten randomly selected pellets was recorded and the mean value was expressed as the number of seedlings was emerged/pellet at 20 days after sowing (DAS), seedling survival and seedling height were recorded at 40 DAS. The date of sowing was considered after receiving of first effective rain after placing pellets in a plot in both the sowing methods. Statistical analysis was done in factorial RBD (Gomez and Gomez, 1984).

Fig 1. Different types of pellets- round-shaped (left), cube-shaped (centre) and cloth pouch (right)

Combined analysis of variance over three years revealed significant differences for both sowing methods and types of pellet for germination and other growth parameters under study. There were no significant interaction effects between the number of seedlings and the type of pellet, indicating that the pellets responded equally under both sowing methods. While significant interaction effects for plant stand/plot at 20 and 40 DAS showed that the sowing method had more impact as compared to types of pellet. The number of seedlings/pellet at 20 DAS in dry sowing ranged from 2.5 seedlings in round-shaped pellets to 4.5 seedlings/pellet in cloth pouches. In normal sowing, it ranged from 3.8 seedlings/pellet in the round-shaped pellet to 5.5 seedlings/pellet in the cloth pouch (Fig 2). The number of seedlings/pellet was more under normal sowing irrespective of the types of pellet and it was highest in cloth pouch (Table 1). The reason for fewer seedlings/pellet in dry sowing might be due to a considerable gap between the receipt of the first rain and subsequent rains.

Appropriate germination of grass seed is highly influenced by the depth of sowing and cloth pouch had an advantage for maintaining proper depth of seed. There was a reduction in the number of seedlings/pellet at 40 DAS as compared to 20 DAS in both dry and normal sowing. On the other hand seedling mortality rate was higher in cloth pouches, which might be due to the low moisture level in the pouch as compared to pellets. Both types of pellets were submerged in the soil, while the

Fig 2. Seedling emergence from round-shaped pellet (left) and cloth pouch (right)

Table 1. Number of seedlings/pellet (three years mean)

Sowing method/ Pellet type	No. of seedlings/pellet at 20 DAS				No. of seedlings/pellet at 40 DAS			
	Round shaped pellet	Cube shaped pellet	Cloth pouch	Mean	Round shaped pellet	Cube shaped pellet	Cloth pouch	Mean
Dry sowing	2.5	3.2	4.5	3.4	1.1	1.4	2.1	1.5
Normal sowing	3.8	4.3	5.5	4.5	3.3	3.8	4.8	4.0
Mean	3.2	3.7	5.0	4.0	2.2	2.6	3.5	2.8
CD ($p < 0.05$)	Sowing method- 0.5; Pellet type- 0.7; Sowing date x Pellet type- NS				Sowing method- 0.9; Pellet type- 0.5; Sowing date x Pellet type- NS			

NS: Non-significant

cloth pouch was not submerged in the soil, which led to more exposure of the cloth pouch to air and sunlight. Cook and Dolby (1981) also observed that pelleting increased establishment in *Cenchrus ciliaris*. Significantly lowest seedling wilting was recorded in pellets made of soil+clay+FYM in a 2:1:1 ratio, while the highest wilting was observed in pellets made of clay alone (Meena and Nagar, 2019). Plant population per plot under normal sowing ranged from 76.6 to 87.8 at 20 DAS which was significantly higher as compared to dry sowing, which ranged from 66.8 to 81.3 per plot. Plant populations also differed significantly in different pellet types irrespective of sowing methods (Table 2). Abusuwar and Eldin (2013) reported that pelleting with FYM performed well in terms of plant density and number of leaves.

The highest plant population per plot was recorded in cloth pouches (84.5), followed by cube-shaped pellets (75.7) and round-shaped pellets (71.1). Considerable reduction in plant population was recorded at 40 DAS as compared to 20 DAS due to seedling mortality. The seedling mortality did not significantly differ among the pellets, while a significant difference between sowing

Table 2. Number of plants/plot (three years mean)

Sowing method / Pellet type	Plant stand/plot at 20 DAS				Plant stand/plot at 40 DAS			
	Round shaped pellet	Cube shaped pellet	Cloth pouch	Mean	Round shaped pellet	Cube shaped pellet	Cloth pouch	Mean
Dry sowing	66.8	70.9	81.3	72.9	51.3	56.5	65.0	57.6
Normal sowing	76.6	80.5	87.8	81.8	73.0	77.8	79.3	76.7
Mean	71.7	75.7	84.5	77.3	62.1	67.1	72.2	67.2
CD ($p < 0.05$)	Sowing method- 8.7; Pellet type- 5.4; Sowing method x Pellet type- 6.2				Sowing method- 10.3; Pellet type- 5.2; Sowing method x Pellet type- 7.3			

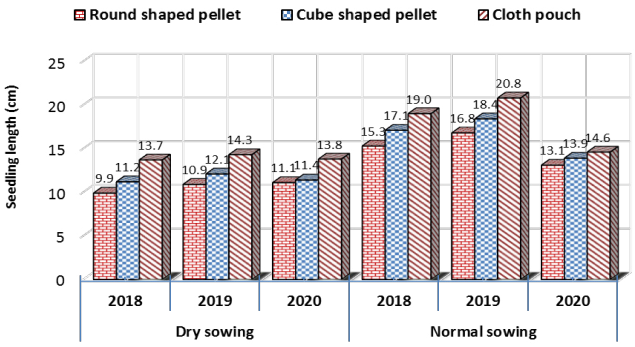

Fig 3. Seedling length (cm) at 40 days after sowing

methods was recorded in pellets, irrespective of type. A significant difference between sowing methods and among the types of pellets was observed for seedling height recorded at 40 DAS which ranged from 11.1 to 14.6 cm. Seedling height was higher in cloth pouches, irrespective of sowing methods (Fig 3). The lower height under dry sowing was probably due to high temperature with low soil moisture and humidity.

It was concluded that seed pellets were beneficial for the judicious use of grass seeds and for achieving uniform field establishment. Cube-shaped pellets were found to be better than round-shaped pellets, and cloth pouches proved advantageous over pellets for achieving a better plant stand. Hence, sowing after receiving 1 to 2 effective rains is the better option in ploughable areas, while dry sowing is more suitable for unploughable fields, sloped areas, forested regions, rocky terrain, and inaccessible locations for successful pasture establishment.

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