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COMPARATIVE EVALUATION OF PELLETING MATERIALS FOR PELLET UNIFORMITY AND HIGHER SEED GERMINATION IN DINANATH GRASS (*PENNISETUM PEDICELLATUM* L.)

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SUMMARY

The most significant drawback of grass seed is their low germination capacity, ranging from 12.0% to 17.5%, coupled with a lack of caryopsis, resulting in poor seed set. To address this issue and promote better seedling establishment, the process of multiple seed pelleting is deemed essential. This investigation focuses on evaluating various filler materials suitable for seed pelleting, specifically aimed at identifying the most economical and efficient option for farm-level use in fluffed seeds of dinanath grass. The experiment involved the assessment of eight different indigenously available fillers: soil, sawdust, wheat bran, charcoal, vermicompost, FYM (Farm Yard Manure), limestone, and biogas slurry powder. Fluffed seeds of dinanath grass were pelleted with these fillers using a gum arabica solution (50%) as the adhesive material. Standardization of filler quantity and adhesive requirement was conducted for each filler material. The laboratory investigation revealed soil to be the most suitable filler material based on various parameters studied. While limestone pellets exhibited the maximum pellet diameter and individual pellet weight, soil pellets demonstrated higher uniformity in pellet diameter and could accommodate the maximum number of seeds within each pellet. Consequently, soil pellets resulted in higher seed germination rates per pellet. Moreover, soil pellets exhibited favorable characteristics such as easy breakage upon water imbibition, rendering them more suitable for pelleting purposes.

Key words: Dinanath grass, seed pelleting, filler material, soil pellets, seed germination

Pennisetum pedicellatum, commonly known as Dinanath grass, is a leafy annual grass with numerous branches that can grow up to one meter in height. It is native to Ethiopia and belongs to the *Poaceae* family. Other names for it include bare, desho grass, and annual kyasuwa grass. As Dinanath grass is having higher nutritious value in terms of phosphorus potassium, calcium and sodium, it can be used for preventing malnutrition in livestock (Shekara and Nagesh 2023).

Livestock is chief source of living for 2/3 rd Indian rural population, that need higher quality fodder every year (Sruthi and Usha, 2019). Grass seeds possess a significant disadvantage as they do not produce caryopsis, leading to poor seed set (Parihar, 2010), with only 12.0% to 17.5% of pure germinating seeds (Maity *et al*., 2017). Therefore, seed pelleting is essential to ensure minimal germination and promote better seedling establishment. Since grass seeds are surface-sown, flood irrigation in the field can wash away the seeds, resulting in lower establishment rates ranging from 0.5% to 3.9% in ryegrass and cocksfoot (Cullen, 1966), and 0-5% in Dinanath grass. Thus, seed pelleting can effectively safeguard the seeds, contributing to higher field emergence.

Seed pelleting is an invigoration technique that has been successfully utilized for many years in various crops to enhance mechanized sowing and increase plant stand. Grass seeds, being very small and covered with multiple appendages, pose challenges for sowing in the main field. The lightweight nature of the seeds complicates the sowing process further, leading to uneven distribution of seeds in the field. As thinning and gap filling require labor-intensive efforts, the production of fodder or seed becomes costlier. Therefore, seed pelleting presents a promising approach to improve fodder establishment with limited initial investment. Studies have shown that pelleting seeds with soil or clay can enhance field establishment compared to surface sowing methods in Dinanath grass (Hull *et al*., 1963; Vartha and Clifford, 1973). Due to the small size of the seeds, grasses typically require increased effort from seeds to withstand environmental stress during initial establishment, highlighting the importance of seedling vigor. Additionally, the hypocotyl must possess sufficient strength to exert the necessary force to emerge above the compact soil surface.

Therefore, pelleting plays a vital role in enhancing the initial vigor by providing the seed with a microclimate that can withstand environmental stress, thereby establishing a conducive environment for growth. For efficient mechanized sowing, pellets with uniform size are essential. Hence, when selecting the filler material, screening should be conducted to ensure uniformity in size and shape.

MATERIALS AND METHODS

The experiment on evaluation of pelleting materials for pellet uniformity and higher seed germination in Dinanath grass (*Pennisetum pedicellatum* L.) was conducted at Department of Seed Science and Technology, College of Agriculture, UAS, Dharwad-580005, Karnataka during 2022. The experiment was carried out in CRD design in three replications. It consisted of eight treatments having different filler materials T1: Soil, T2: Saw dust, T3: Wheat bran, T4: Charcoal, T5: Vermi compost, T6: FYM, T7: Lime stone, T8: Biogas slurry powder. Gum arabica (50 %) @ 7000 ml/kg of seed or rice glue was used as adhesive material.

Fluffed seeds of Dinanath grass variety Bundel -2 was obtained from Indian Grassland and Fodder Research Institute (IGFRI), Jhansi, Uttar Pradesh. Filler materials for this experiment were collected locally and sieved with 1.0 mm wire mesh sieve to obtain uniform and fine filler particle size. Sterilization was done in hot air oven to prevent contamination of pathogens originated from the filler materials. Filler materials were kept inside oven in an oven safe container like a metal pan, covered with foil and temperature of the oven were set to 82-93°C for a period of 30 minutes. Gum arabica was used as binding agent.

For standardization of a suitable filler material, the pelleted seeds were evaluated for parameters like pellet diameter (mm), pellet weight (g), number of seeds per pellet, number of seeds germinated per pellet, pellet germination (%), number of pellets produced per kg of filler and time taken for pellet dissolving.

Ten gram of fluffed seeds were taken into a metal container of 15 cm radius and 35 ml of gum arabica solution was measured by a volumetric flask and half of the gum solution were sprayed using a spray bottle to spread the gum uniformly over the seed surface. Then half of the filler quantity was added to a metal container attached to a manually operated rotating drum. The container was rotated at 80 RPM for 3 minutes. Remaining gum solution was sprayed and remaining half of filler was added and same rotation procedure was applied for specified time. The procedure was standardized by adding filler material and gum solution into multiple small dosages and finally standard dosage was obtained. After pellet formation the pellets were collected and spread in shade condition for drying.

For germination test, twenty-five pellets were kept in each petri dishes in moistened blotter paper with four replications at 20°C. Observations were taken for pellet germination per cent and number of seeds germinated per pellet at the final count. Further, other parameters of pellet quality such as pellet weight, number of seeds per pellet, number of pellets produced per kg of filler and time taken for pellet dissolving were also recorded and evaluation were done for pellet quality.

The data were statistically analyzed as per the method outlined by adopting analysis of variance technique appropriate to the level of treatments. Critical differences were calculated at 1 per cent level, where 'F' test was significant (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Since the dinanath seeds are very light in weight, only 10 g of seeds were taken for pelleting in a single batch to avoid clumsiness. It has been noticed that when more seeds were taken for pelleting in each batch, pellet formation was improper. Either, empty pellets were formed with seeds remain unattached with the filler or big and un-uniform with bold shaped pellets were formed with numerous seeds inside. The requirement of filler material and gum arabica varied among the filler materials. Saw dust and wheat bran was required in higher quantity (90 g) for pelleting of 10 g of seed. Whereas, others fillers were required in comparatively less quantity (80 g per 10 g of seeds). Gum requirement was higher for FYM and limestone pellet formation (50 ml per 10 g of seed) (Table. 1).

TABLE 1
Standardization of filler material quantity and adhesive requirement for seed pelleting

Filler materials	Seed taken for pelleting/ batch (g)	Quantity of filler material required (g)	Volume of adhesive required (ml)	Rotation of pelleting drum (RPM)	Duration of operation (minute)
T_1: Soil	10	80	35	80	3
T_2: Saw dust	10	90	45	80	3
T_3: Wheat bran	10	90	40	80	3
T_4: Charcoal	10	80	35	80	3
T_5: Vermi compost	10	80	35	80	3
T_6: FYM	10	80	50	80	3
T_7: Lime stone	10	80	50	80	3
T_8: Biogas slurry powder	10	80	35	80	3

The treatment, soil as base material @ 1600 g/100 g of seed registered most uniform pellet diameter of 5.0 mm followed by vermicompost as base material @ 1600 g/ 100 g of seed with pellet diameter of 5.2 mm (Table 2). Whereas, highest pellet diameter was obtained from lime stone as base material @ 1600 g/ 100 g of seed of 6.8 mm which was not suitable as the pellets were less uniform in their shape. Pellet formation from limestone powder was slow which makes it not suitable for pelleting. Pellets obtained from sawdust, wheat bran, charcoal, FYM and biogas slurry powder also showed less uniformity in pellet size. Pellets produced from soil and vermicompost was round in shape, fast in formation and most of the pellets were uniform for their size.

TABLE 2
Effect of different filler materials on seed pelleting for pellet diameter, pellet weight and number of seeds per pellet in Dinanath grass cv. Bundel -2

Treatments	Pellet diameter (mm)	Pellet weight (g)	Number of seeds/pellet
T_1: Soil	5.0	0.52	7
T_2: Saw dust	4.3	0.17	5
T_3: Wheat bran	6.0	0.36	3
T_4: Charcoal	4.8	0.16	4
T_5: Vermi compost	5.2	0.27	5
T_6: FYM	4.5	0.07	3
T_7: Lime stone	6.8	0.68	2
T_8: Biogas slurry powder	3.8	0.14	3
Mean	5.1	0.30	4
S. Em±	0.22	0.003	0.19
C. D. @ 1 %	0.91	0.014	0.82

The highest single pellet weight was obtained from lime stone (0.68 g) followed by soil (0.52 g). Lime stone produced maximum single pellet weight ranging from 0.60 g to 1.0 g, was mostly un-uniform for their weight. Although results of this experiment show that lime stone is not suitable for pelleting but few results supported lime stone as a good filler material (Hastings and Drake, 1962; Lowther and Johnstone, 1979). Pellets produced from soil showed maximum uniformity for their weight ranging from 0.50 g to 0.55 g. The least pellets weight was obtained from FYM (0.07 g), biogas slurry powder (0.14 g), charcoal (0.16 g) and sawdust (0.17 g) (Table. 2). The pellets produced from them were less uniform for their weight and considered not suitable for pelleting.

The highest number of seeds per pellet was obtained from soil (7 seeds) followed by saw dust (5 seeds) and vermicompost (5 seeds) (Table 2). Soil pellets, most uniform in size and weight was able to retain more seeds inside. High attachment of soil particles with the sticky seed surface resulted in a greater number of seeds in a single pellet. Madsen *et al.* (2012) reported that, when seed attachment is very high with filler material, there are better chances of grass establishment. Lowest two seeds were obtained from lime stone pellets followed by three seeds was obtained from wheat bran, FYM and biogas slurry powder, respectively. Lime stone recorded less number (2) of seeds per pellet as the seed attachment with lime stone powder was very poor resulted in formation of even empty pellets in some cases.

The highest pellet germination percentage was recorded from soil (58.7 %) followed by vermicompost (57.3 %) (Table.3). Soil and vermicompost pellets with higher number of seeds had greater chance for pellet germination. Probably because of having multiple seeds inside in the conducive microclimate of pellet, the cumulative strength can provide sufficient potential to the emerging seedlings for penetrating through the compact soil (Edwards, 1966; Awadhwal and Thierstein, 1985). The lowest pellet germination percentage was recorded from wheat bran (0 %) as

TABLE 3
Effect of different filler materials on pellet germination, number of seeds germinated per pellet, number of pellets produced per kg of filler and time taken for pellet dissolving in Dinanath grass cv. Bundel -2

Treatments	Pellet germination (%)	No. of seeds germinated/ pellet	No. of pellets produced/kg of filler	Time taken for pellet dissolving (minute)
T_1: Soil	58.7	2.2	1921	30
T_2: Saw dust	42.7	1.0	5850	85
T_3: Wheat bran	0.0	0.0	2763	110
T_4: Charcoal	48.0	1.1	6440	10
T_5: Vermi compost	57.3	1.9	3708	90
T_6: FYM	30.7	0.4	15344	35
T_7: Lime stone	6.7	0.1	1474	80
T_8: Biogas slurry powder	12.0	0.1	7169	20
Mean	32.0	0.9	5584	57
S. Em±	3.02	0.09	341.6	0.118
C. D. @ 1 %	12.48	0.37	1411	0.487

the pellets showed greater incidence of mould growth. High moisture retention ability and relative humidity in the initial period of germination of wheat bran might resulted in higher incidence of mould growth (Wright and Tomkins, 1940). Cavalcante *et al*. (2008) reported that wheat bran naturally acts as a substrate for growth of several fungal microorganisms.

Seed germination per pellet was highest for soil (2.2 seeds) followed by vermicompost (1.9 seeds) (Table. 3). Soil and vermicompost is a good source of nutrients which might have supplemented with high seed germination per pellet. Findings of Yadav *et al*., (2000) suggests that grass seeds pelleted with soil as a filler material could give higher germination. In this study, germination of grass seeds pelleted with wheat bran, lime stone and biogas slurry powder was hindered substantially. The possible reason might be the gluing material affected the hygroscopic properties of the filler materials and resulted in more absorption of water (Eric, 1979). Although, seed germination per pellet from FYM was lower, few results suggested that pelleting with FYM produced satisfactory germination (Abusuwar and Eldin, 2013).

The highest number of pellets per kg of filler was obtained from FYM (15344) followed by biogas slurry powder (7169) (Table. 3). The number of pellets per kg of filler depends on pellet weight. Pellets with less weight were produced more in numbers compare to pellets with high weight produced less in number.

Among the treatments, charcoal pellets took least time (10 minute) for pellet dissolving and wheat bran pellets took highest (110 minute) time (Table. 3). The water holding capacity, integrity of the filler material and other properties of the pellets are also very important for pasture development. Fast pellet dissolving of charcoal pellet shows loose structural integrity of the filler whereas slow pellet dissolving shows rigidness. Soil took 30 minutes for pellet dissolving, shows that soil structural integrity is moderate enough to hold the pellet in water and not too rigid to prevent absorption. Soil particles which have been used in this experiment favored high rate of water absorption and withhold adequate moisture inside the pellet which might have favored seedling establishment (Li *et al*., 2000; Shawabkeh and Tutunji, 2003). Soil, being a good source of silicon might have contributed in providing essential growth for seedlings (Antonides, 1997).

CONCLUSION

Seed pelleting in Dinanath grass with soil as a filler material has shown wide advantages over other materials. Filler material and adhesive requirement was almost same for all the filler materials for pelleting. This process of seed pelleting using indigenously available filler materials can reduce the initial cost of pelleting and more appropriate method for higher fodder production through very good crop stand.

REFERENCES

Abusuwar, A. O. and A. K. Eldin, 2013 : Effect of seed pelleting and water regime on the performance of some forage species under arid conditions. *American-Eurasian Journal of Agricultural & Environmental Sciences*. **13**(5): 728-734.

Antonides, L. E. 1997: Diatomite: U.S. geographical survey mineral commodity summaries. pp. 24.1-24.4.

Awadhwal, N. K. and G. E. Thierstein, 1985: Soil crust and its impact on crop establishment: a review. *Soil Tillage Res*earch. **5**: 289-302.

Cavalcante, R. S., Lima, H. L. S., Pinto, G. A. S., Gava, C. A. T. and S. Rodrigues, 2008: Effect of moisture on *Trichoderma* conidia production on corn and wheat bran by solid state fermentation. *Food Bioprocess Technology*. **1**: 100-104.

Cullen, N. A. 1966: The establishment of pasture on yellow brown loams near Teanau. III. Factors influencing the establishment of grasses on uncultivated ground. *New Zealand Journal of Agricultural Res*earch. **9**: 363-374.

Edwards, F. E. 1966: Cotton seedling emergence. *Mississippi Farm Res*earch. **14**: 343-353.

Eric, E. R. 1979: Storage behavior of pelleted, tableted and taped lettuce seed. *Journal of the American Society for Horticultural Science.* **104**: 283-288.

Hastings, A. and A. D. Drake, 1962: Tests with materials for pelleting inoculated clover seed. *New Zealand Journal of Agriculture.* **104**: 330-333.

Hull, A. C. Jr., Holmgren, R. C., Berry, W. H. and J. A. Wagner, 1963: Pelleted seedling on western rangelands. *USDA and USDI Miscellaneous Publication*. pp. 34.

Li, D., Joo, Y. K., Christians, N. E. and D. D. Minner, 2000 : Inorganic soil amendment effects on sand based sports turf media. *Crop Sci*ence. **40**: 1121-1125.

Lowther, W. L. and P. D. Johnstone, 1979: Coating materials for commercial inoculated and coated clover seed. *New Zealand Journal of Agricultural Research.* **22**: 475-478.

Madsen, M. D., Davies, K. W. Williams, C. J. and T. J. Svejcar, 2012: Agglomerating seeds to enhance native seedling emergence and growth. *Journal of Applied Ecology.* **49**: 431-438.

Maity, A., Vijay, D., Singh, S. K. and C. K. Gupta, 2017: Layered pelleting of seed with nutrient enriched soil enhances seed germination in Dinanath grass (*Pennisetum pedicellatum* L.). *Range Management and Agroforest*ry. **38**(1): 70-75.

Parihar, S. S., 2010: Status of seed science research in tropical range grasses and future needs. *Range Management and Agroforest*ry. **31**: 79-86.

Shawabkeh, R. A. and M. F. Tutunji, 2003: Experimental study and modeling of basic dye absorption by diatomaceous clay. *Applied Clay Sci*ence. **24**: 111-120.

Shekara, B. G., and C. Nagesh, 2023: Green forage yield, nutritional value and economics of dinanath grass genotypes as influenced by nitrogen levels. **57**: 347-353.

Snedecor, G. and W. G. Cochran, 1967 : Statistical Methods. Oxford and IBH Publishing Company, Bombay, pp. 135-197.

Sruthi, L. T. and C. T. Usha, 2019: Innovative techniques in fodder production-a review. *Forage Research.* **44**(4): 217-223.

Vartha, E. W. and P. T. P. Clifford, 1973 : Effect of seed coating on establishment and survival of grasses, surface-sown on tussock grasslands. *New Zealand Journal of Experiemental Agriculture Internatinal.* **11**: 39-43.

Wright, B. E. C. and R. G. Tomkins, 1940: The moisture content and growth of mould in flour, bran and middlings. *Cereal Chemistry*. **17**(3): 332-342.

Yadav, M. S., Sharma, S. K. and M. P. Rajore, 2000: Effect of pelleting material on seed germination and grassland productivity. *Range Manage. Agroforestry.* **21**(2): 121-127.