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EFFECT OF DIGESTIVE SYSTEM OF SOME RUMINANT ANIMALS IN BREAKING DORMANCY OF *ACACIA NILOTICA* SEEDS

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ABSTRACT

Seeds of some plant species have hard, cutinized seed coats that completely prevent the inhibitions of water and sometimes also the exchange of gases. Dormancy in nature serves to protect the seed from conditions which are temporarily suitable for germination. However, where dormancy is strong, some form of seed pre-treatment is essential in artificial regeneration, in order to obtain a reasonably high germination rate in a short time. Seeds of some species are said to be regurgitated after partial rumination. Feeding the pods of *Acacia nilotica* through the digestive system of some animals (sheep and goat) and collecting the seeds from the droppings as a convenient pre-treatment to overcome seed coat dormancy. After digestion, four hundred (400) treated seeds were collected from the feacal of both animals by washing with distilled water and placed on moist cotton in a petri dish. The results revealed that 80 % of seeds passing through the digestive system of (sheep and goat) had higher germination rate.

Keywords: *Acacia nilotica, Digestive system, Dormancy.*

INTRODUCTION

Seeds of many tree species germinate readily when subjected to favorable conditions of moisture and temperature (Jibo, 2008) and many other species possess some degree of seed dormancy (Baskin and Baskin, 2004). Dormancy in nature serves to protect the seed from conditions which are temporarily suitable for germination but which quickly revert to conditions too harsh for survival of the tender young seedling (Finch-Savage and Leubner-Metzger, 2006; Salami and Lawal, 2018). Where dormancy is strong, some form of seed pre-treatment is essential in artificial regeneration, in order to obtain a reasonably high germination rate in a short time.

Seeds of some species have hard, cutinised seed coats that completely prevent the imbibitions of water and sometimes also the exchange of gases. Without inhibitions and gas exchange renewal of embryo growth and germination are impossible. Physical seed coat dormancy of this kind occurs most frequently in species adapted to alternating dry and wet seasons, including several leguminous genera such as *Acacia, Prosopis, Ceratonia, Robinia, Albizia, Cassia*.

Breaking seed coat dormancy may occur naturally as a result of temperature fluctuations, abrasion and microbial, insect damage or passing through the digestive system of some animals like sheep and goat. Breaking seed coat dormancy by scarification breaks the seed coat and exposes the lumens of the macrosclereids cells, allowing the seed to imbibe water.

Acacia nilotica have the thickest seed coat among the Acacias, imposing seed coat dormancy (Jibo, 2008; Salami and Lawal, 2018). The exact mechanisms of physiological dormancy of the embryo, and of the processes which can terminate it, have been widely investigated but underlying causes are still little understood (Krugman *et al.*, 1974).

Seed germination in tree species is sometimes difficult due to hard seed coat and dormant embryos (Salami, 2018) and the seeds often fail to germinate even under favourable moisture, oxygen and soil conditions. To overcome this problem, several methods including mechanical scarification, soaking in water and acids (Patane and Gresta, 2006), chilling and heating (Beigh, 2002; Salami and Lawal, 2018) and irradiation (Jan *et al*., 2012; Aref, 2016) are used for treating seeds prior to sowing. Acid, hot water and mechanical scarification are the common treatments employed to overcome seed coat dormancy (Abubakar and Maimuna, 2013; Nasr, Savadkoohi, and Ahmadi, 2013). Other treatments at experimental levels were use of electrical; however animals and microorganisms are known to break seed dormancy. It is difficult to make use of these organisms as a controlled pre-treatment of seed, but in a few cases successful results have been obtained. Seeds of *Acacia senegal* and *Ceratonia siliqua* that have passed through the digestive tracts of goats germinate readily when placed in favourable conditions (Doran *et al.*, 1983), because of the action of the strong digestive chemicals. The capacity of seeds to germinate after ingestion by frugivorous is important for the population dynamics of some plant species and significant for the evolution of plant frugivorous interactions (Traveset, 1998). Feeding the pods to penned goats and collecting the seeds from the droppings is a convenient pre-treatment for these species (Goor and Barney, 1976). Seeds of some species are said to be regurgitated after partial rumination e.g. *Gmelina arborea* (Greaves, 1981). Prasad (1999) states that seeds of *Acacia nilotica* are ejected after rumination by sheep and goats but pass right through the digestive tract in cattle. In either case, germination is improved by the digestive action. The aim of this research work is to improve the production of *A nilotica* in Yobe State through identifying and establishing an acceptable method of breaking the seed dormancy. Therefore the objectives of this study is to investigate the best method in breaking *A. nilotica* seed dormancy and to study the germination rate of seeds passing through the digestive system of some ruminant animals.

MATERIALS AND METHODS

Seed collection

Pods containing matured seed of *A nilotica* were collected from tree stand in Geidam (Lat 12º 88' N and Long 11º 92'E) Yobe State Nigeria.

Table 1: Design of *A nilotica* germination trial.

Treatment	Number of seed	Replication	Number of seed per replication
Control (U)	400	4	100
Goat (G)	400	4	100
Sheep (S)	400	4	100
Cow (C)	400	4	100

Each pre-treatment was divided into four (4) replications of 100 seeds each (Table1) and placed in a 9 cm Petri dishes containing cotton wool. The treatments were:
Control (U): 400 untreated seed of *A nilotica* were placed on moist cotton in a petri-dish to serve as control.
Goat (G): Pods containing matured seed of *A nilotica* were mix with animal feed and fed to the goats, Fig.1. 400 seed of *A nilotica* were then collected for the droppings of the goat thoroughly washed with distilled water and placed on moist cotton in a petri-dish.

Fig.1: *Goat feeding on mix of pods of matured seed of A. nilotica and animal feed.*

Sheep (S): Pods containing matured seed of *A nilotica* were mix with animal feed and fended to the Sheep, Fig. 2. 400 seed of *A nilotica* were then collected for the droppings of the sheep, thoroughly washed with distilled water and placed on moist cotton in a petri dish.

Fig. 2: Sheep feeding on mix of pods of matured seed of A. nilotica and animal feed.

Cow (C): Pods containing matured seed of *A nilotica* were mix with animal feed and fed to the Cows, 400 seeds of *A nilotica* were then collected for the droppings of the cows, thoroughly washed with distilled water and placed on moist cotton in a petri dish.

RESULTS AND DISCUSSION

The seeds were considered germinated when the tip of the radicle had grown free of the seed coat Fig 4. Seedlings began to emerge 2 days after sowing and 53.93% seed germination was obtained over a period of 22 days Table 2.

Table 2 Data collected over 22 days

	DAYS AFTER PRE-TREATMENT											
Treatment	**Replication**	2	4	6	8	10	12	14	16	18	20	22
Control (U)	1	0	0	6	1	0	2	0	0	0	0	0
	2	0	0	6	0	1	0	0	1	0	0	0
	3	0	0	4	3	1	1	1	0	1	0	0
	4	0	0	1	0	0	1	0	1	0	0	0
Goat (G)	1	0	29	30	15	6	0	1	0	0	1	0
	2	2	20	34	6	8	7	5	0	0	0	0
	3	1	15	16	6	12	9	15	2	0	0	0
	4	0	15	26	14	8	16	1	3	0	0	0
Sheep (S)	1	1	7	28	15	2	3	1	0	0	0	0
	2	1	17	31	5	6	2	1	0	0	0	0
	3	2	16	9	11	8	3	4	1	0	1	0
	4	0	8	5	4	6	12	6	0	1	1	0
Cow (C)	1	0	11	25	8	12	1	1	6	0	1	0
	2	1	6	15	7	1	1	6	0	0	0	0
	3	1	5	6	2	7	1	0	1	0	0	0
	4	0	0	0	0	0	0	0	0	0	0	0

Fig. 4: Germinated seeds of A nilotica

STATISTICAL ANALYSIS

One way analysis of variance (ANOVA) was carried out to test any difference among the treatment and seed germination and the interactions on the measured variables using the general linear model (GLM) Significance levels were taken at 5% level. All analyses were performed using the statistical software Minitab v.16 (State College PA). No transformations were needed if variables tended to be distributed with normality otherwise, they were log-transformed to achieve the assumptions of ANOVA, the distribution pattern of residuals for the tests.

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RESULTS

Test for viability

The viability test of the seeds was carried out using simple floating test. Seeds were immersed in distilled water contained in 500ml of liquid. These seeds found floating was considered to be damaged or bad for germination, such seeds were discarded. Whereas those that settled at the bottom of the water were termed to be viable for germination. Sample of the seeds where then taken and subjected to germination inducing treatment. The viability test show that the seeds of *A nilotica* used for this study were viable, out of the 500 seeds used for the viability test 98.2 % were viable, while 1.8 % were not viable.

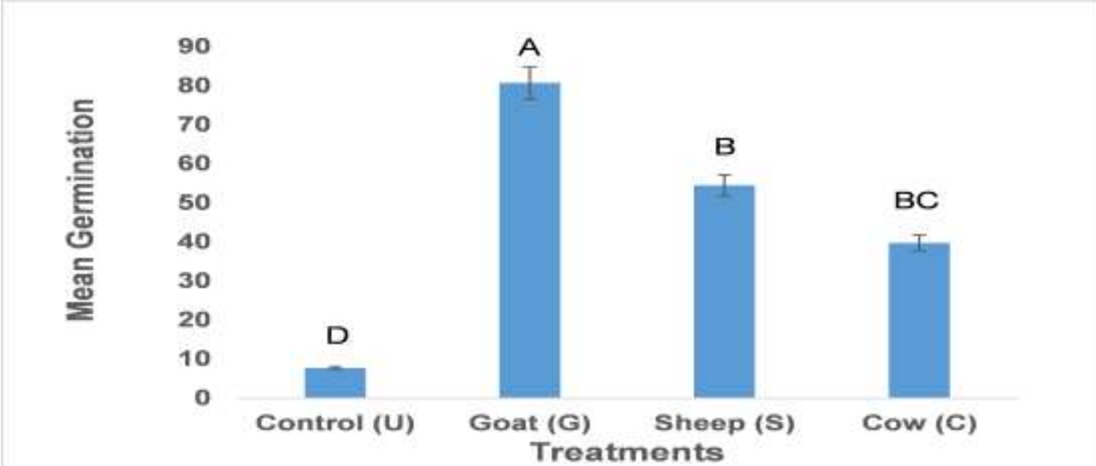

Fig. 5: Mean (±SE) number of seeds germinated in the different treatment n= 100 mean with different letter are significantly different P<0.001.

The highest number of germination was recorded in the goat treatment, the sheep treatments showed a similar rate and pattern of germination when compared with the goat treatments, however the least germination occurred in the cow treatment. The pattern and rate of germination in cow treatment is similar to that of the control (Figure 5).There was a significant difference among the treatments ($F_{3, 15}=36.03$, $P< 0.001$). The germination rates were significantly affected by the treatment ($p< 0.001$).

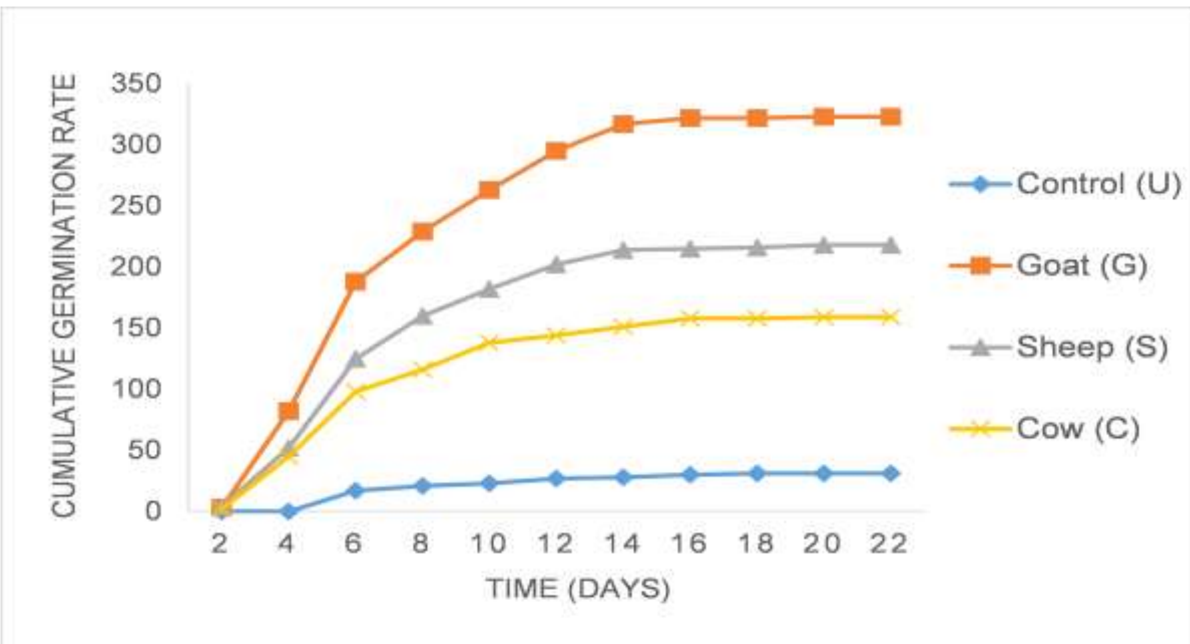

***Fig. 6**: Cumulative germination rate 22 days after sowing.*

Higher cumulative germination rate of seeds were recorded from seeds pretreated within rumen of goat with observed number of three hundred and fifty (350), followed by seeds pretreated within rumen of sheep which recorded two hundred (200). The least cumulative germination rate was fifty (50) all within 22 days of experimentation. Many seeds will not germinate unless water content has been reduced by dry storage (Jibo, 2008). This is a common adaptation in desert tree like *Acacia*, which experience a seasonal rhythm of water availability. Single or multiple dormancy mechanisms can ensure germination at an appropriate time.

This result is in agreement with Ahmed, (2015). Nasr *et al.*, (2013), Rasebeka *et al.*, (2014), Jibo (2008), Cosyns *et al.*, (2005) and Or *et al.*, (2003), who reported that immersing dry seeds of other tropical tree species enhanced seed germination. The outcome of seed passage through a digestive tract may depend on the animal species that consumes it (Traveset, 1998). The dental formula of herbivorous mammals are modified in several ways, to crush, grind or shred plant matter, so also are the chemical environment of the digestive tract modified to extract nutrients in an effective way, usually harboring symbiotic bacteria and protozoa which can digest the structural polymers of the cell wall through fermentation. Ruminant artiodactyls (e.g. cows, deer and sheep) have a refined stomach fermentation which takes place in the two compartments, rumen and reticulum.

CONCLUSION

Seeds pre-treated within the rumen of Goat showed the best germination and growth vigour performance. *Acacia* species are characterized by physical dormancy (seed coat dormancy). Poor seed germination is caused by the water impermeable seed coat which act as barrier to entry of moisture and gasses and this exerts physical dormancy. This might indicate the important role of this animal in dispersal and germination process.

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