

Storage Period, Husking and Seed Treatment Effects on Germination of Rhodes Grass (*Chloris gayana* L.) Seeds

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Abstract	Article Information
Seed dormancy is among the major problems associated with pasture establishment from Rhodes grass. Two experiments were conducted with the aim to assess the effects of storage period (years), husking and seed treatment on germination rate of Rhodes grass seeds of two cultivars, Callide and Masaba, at Kulumsa and Debre Zeit Research Centers. The first experiment included two seed lots (harvested in years 2013 and 2014) and two husking treatments (husked and with husk) laid out in split plot design with four replications. The second experiment had three seed lots (harvested in 2012, 2013 and 2014), three chemical treatments (KNO ₃ , Ethanol, and H ₂ O) and untreated control for each lot in randomized complete block design with three replications. In the first experiment, germination rate ranged from 13.5% in freshly harvested seeds with husk to 85.5% in aged seeds without husk. Husking improved germination and this may be attributed to improved access of embryo to water, exclusion of empty husks and elimination of physical barriers to germination. In the second experiment, germination rate ranged from 3.3% in untreated fresh seeds to 21.1% in seeds harvested in 2012 and pre-treatment with KNO ₃ solution. In conclusion, freshly harvested seeds of Rhodes grass have very low germination rate in both experiments while husk removal and pre-soaking in KNO ₃ solution improved performance in new as well as older seed stocks. However, it is recommended that further study should be carried out to come up with comprehensive information on the period required in months to achieve maximum possible germination rate; the interactive effects of husking, chemical treatment, and genotype; and the underlying mechanism of dormancy.	Article History: Received : 20-07-2015 Revised : 17-09-2015 Accepted : 19-09-2015 Keywords: <i>Chloris gayana</i> L., Dormancy Seed priming Germination *Corresponding Author: Karta K. Kalsa E-mail: kartakaske@gmail.com
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INTRODUCTION

Rhodes grass (*Chloris gayana* L.) is among the mostly used pasture grass species in Ethiopia. It can be established as sole pasture or in mixture with herbaceous legumes (Solomon Mengistu, 2008). Seed dormancy is among the major problems associated with pasture establishment from tropical grasses including Rhodes grass (Shanmugavalli *et al.*, 2007). In tropical herbage grasses such as Rhodes grass, the seed dormancy characteristics have not been substantially altered by plant breeders (Adkins *et al.*, 2002). The natural persistence of such species depends on their ability to reseed and their dormancy strategy (Pistorale, S., 1999). Freshly harvested seed of Rhodes grass may require post-harvest storage period up to six months before achieving adequate germination for pasture establishment (Cook, *et al.*, 2005).

Type of seed treatment to break dormancy depends on the mechanism of dormancy: mechanisms based within the embryo covering structures, and mechanisms based within the embryo (Bewley, 1997). Mechanisms within the covering structures may involve mechanical, permeability and chemical barriers to germination whereas mechanisms within the embryo may involve the expression of certain genes, levels of certain plant growth

regulators, the activity of important respiratory pathways or the mobilization and utilization of food reserves (Adkins *et al.*, 2002). It is well documented that certain tropical and sub-tropical grass species have positive response to post-harvest storage until certain period of time (Kawonga, 1997). Besides, seed treatment methods such as acid-digestion (Stevens *et al.*, 2015) and soaking in KNO₃ solution or priming in water (Nichols *et al.*, 2012) are also recommended to alleviate dormancy problems in grasses. The present study was initiated with the aim to assess the effects of storage period (years) and seed treatment on germination rate of Rhodes grass seeds.

MATERIALS AND METHODS

Two experiments were conducted to understand the effects of seed storage period, husking and chemical treatment on germination characteristics of Rhodes grass. The first experiment was conducted using Rhodes grass cv. Callide at Kulumsa Agricultural Research Center. Seed stocks produced and harvested at Kulumsa in December 2013 and 2014 were used for the experiment. Working samples were prepared based on the prescribed standards. The submitted sample of 1000g from each seed stock was used as working sample (ESA, 2012).

The working sample was further divided into two portions and 50g was taken from each portion to conduct the germination test with or without husks. The seed stocks (2013 and 2014 harvests) were considered as main plot factor while the husking treatments (husked and with husk) were used as sub-plot factor. Hundred seeds were sown on top of a 150mm blotter paper saturated with distilled water per replicate and placed in plastic bowls. The bowls, then, were placed at room temperature for 14 days and germination was recorded based on normally germinated seeds.

The second experiment was conducted using cv Masaba at Debre Zeit Agricultural Research Center. Seed stocks harvested at Debre Zeit in December 2012, 2013 and 2014 were used for the experiment. Chemical treatments used were 2% KNO₃, 50ppm Ethanol and distilled water (H₂O). The seeds were soaked in the chemical treatments for 24 hours and dried back to the normal moisture content before germination test. The 3x4 factorial treatment combinations were laid out in randomized complete block design with three replications. Analysis of variance and mean separation was carried out using the R-software packages. Percentage data were log transformed before subject to analysis of variance while mean separation was carried out on the percentage data at 5% level of probability.

RESULTS AND DISCUSSION

Experiment I

Results from the analysis of variance on transformed germination data for the effects of storage period, husking treatment and their interaction is presented in Table 1. The effect of storage period, husking and their interaction was highly significant ($p < .001$). Germination performance of seed from storage periods was significantly dependent on use of husked seed or seed with husk.

Table 1: Analysis of variance on effect of husking and seed age on seed germination of Rhodes grass cv. Callide harvested in different years at Kulumsa

Source of variation	Degree of Freedom	Mean Squares	p level
Replication	3	0.0023	NS
Year of Harvest (Y)	1	0.2256	***
Error a	3	0.0056	
Husking (H)	1	1.2656	***
Y x H	1	0.1806	***
Error b	6	0.0031	

***Significant at 0.001 level of probability

Germination rate ranged from 13.5 on freshly harvested seeds with husk to 85.5% on aged seeds without husk. Germination percent was generally low for seeds with husks in either of seed ages. However, higher mean germination rates were recorded by removing husks, the values being close to 86 and 75%, for seed stocks of 2013 and 2014, respectively. Though husk removal improved germination performance, it had better effect on the older stocks. Improvement in germination performance of Rhodes grass seeds on husked seeds might be attributed to different factors such as enhanced access of the caryopsis to moisture, exclusion of empty husks from the germination test, and removal of physical barrier. Previous studies indicated that the main

mechanisms of glumes were the mechanical resistance of glumes (Ma *et al.*, 2010). Therefore, seed quality testing laboratories need to consider husk removal treatment before germination tests are conducted.

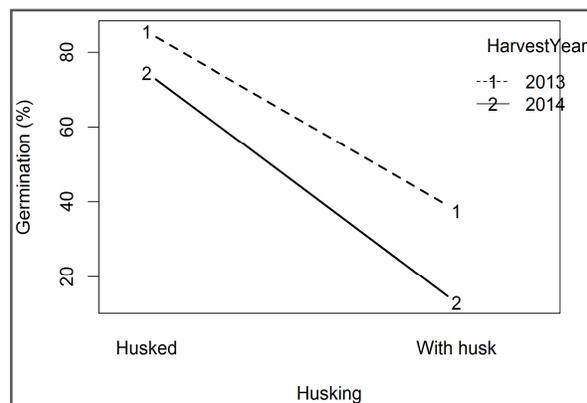


Figure 1: Germination performance of Rhodes grass seed stocks with and without husks. LSD= 5.6 (0.11) %, where number in parenthesis is for transformed data

Experiment II

The second experiment was conducted on cv Masaba, produced and harvested at Debre Zeit Agricultural Research Center. Chemical treatments were applied on seeds with husk. Analysis of variance indicated that the statistically significant main effects of chemical treatment and duration of storage ($p < 0.001$) on germination rate (Table 2). The effect of the interaction of the two factors was also significant ($p < 0.01$).

Table 2: Analysis of variance for the effects of chemical treatment of Rhodes grass seeds harvested in different years at Debre Zeit

Source of variation	Degrees of Freedom	Mean Squares	p level
Replication	2	4.95	
Treatment	3	115.18	***
Year	2	152.26	***
Treatment xYear	6	22.77	**
Residuals	22	4.55	

***, **Significant at 0.001 and 0.01 levels of probability

Seed germination rate (%) was positively associated with seed age. Regardless of seed treatment, older seed lots demonstrated relatively better germination than that of freshly harvested ones (Figure 2). Germination rate mean values for treated seeds were lower for freshly harvested seeds than aged ones. However, priming (pre-soaking) in KNO₃ solution significantly ($p < 0.05$) improved germination rate of seeds, values ranging from 11.6% for 2014 to 21.1% for 2012, as compared to the untreated controls. These findings are in conformity with previous reports on the post-harvest storage requirements of Rhodes grass seeds to achieve maximum germination (Kawonga, 1997). However, the findings in Experiment I indicated that the germination percentage might be higher if the husks were removed and chemical treatments were applied (Ma *et al.*, 2010) on naked caryopses.

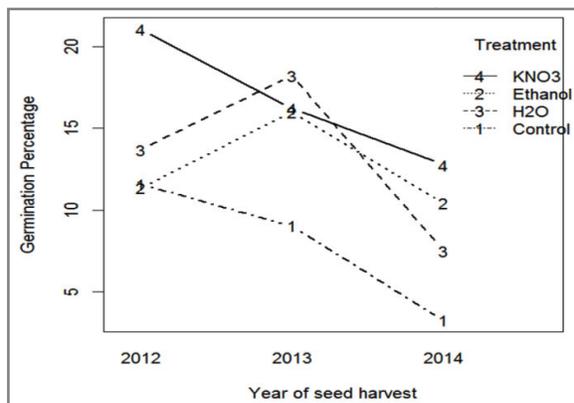


Figure 2: Effects of chemical treatment on germination percentage of Rhodes grass seeds harvested in different years at Debre Zeit. LSD (0.05)= 3.13%

CONCLUSIONS

Germination performance of Rhodes grass seeds ranged from 3% to above 85% depending on seed age, husking and chemical treatment application. Freshly harvested seeds of Rhodes grass had low germination rate as compared to that of aged ones. Husk removal might have improved germination by improving access of the embryo to water, excluding empty husks and eliminating physical barriers for germination. Pre-treatment with KNO₃ has enhanced seed germination but, removal of husks in combination with chemical pre-treatment might have better effect.

The present study has some limitations that further investigations need be carried out. The experiments were conducted on seeds harvested in separate years and do not show the required period of storage in months for maximum germination. It also has deficiency in indicating the combined influence of husking, chemical treatment, and genotypes on germination rate. Moreover, the prevailing dormancy mechanism (whether it is purely after-ripening requirement or combined with mechanical barrier) is also vaguely understood. Therefore, it is recommended that further study should be carried out to come up with comprehensive information on the period required in months to achieve maximum possible germination rate; the interactive effects of husking, chemical treatment, and genotype; and the underlying mechanism of dormancy.

Conflict of Interest

Conflict of interest none declared

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