Modeling the Effect of Storage Duration on Germination Percentage of the Seeds of *Azadirachta Indica* A. Juss, *Conocarpus Lancifolius* Engl & Diel and *Sterculia Setigera* Delile

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Abstract- This work depended on data obtained from an experiment to study the effect of storage temperature, packing method and storage duration on the germination percentage of seeds of *Azadirachta indica*, *Conocarpus lancifolius* and *Sterculia setigera*. In that study, the analysis of variance revealed that the only significant effect was that of storage duration. This present work is a further statistical analysis to examine the relationship between storage duration and germination percentage of the seeds of the three species. The mean germination percentages, averaged over all levels of packing methods and storage temperatures, were obtained against storage duration for each of the three species. Regression models of germination percent on storage duration were built for the three species. The curve estimation procedure of the SPSS (Version18) statistical package was used in building of models. The three regression models depicted a cubic relationship according to the best fit indicated by the most significant coefficient of determination ($R^2$).

Index Terms- Modeling, Germination percent, Storage duration.

I. INTRODUCTION

The propagation of *Azadirachta indica* (Neem) from seed is hampered by its short storage longevity [1]. Neem seeds do not retain their viability very long and have to be sown within 2 or 3 weeks after harvest [2]. Seeds of *Conocarpus lancifolius* (Damas) have a low initial germination percentage of 25 [3]. A graph drawn for germination percentage against storage duration [4] shows that germination percentage of seeds falls with the lapse of time. This means that the low initial germination percentage of Damas will be negatively affected by storage duration. Seeds of these two species together with seeds of *Sterculia setigera*, are considered difficult seeds by the Standards of Kew Botanical Gardens, either because of their initial germination percentage or because they lose their viability with lapse of time [5]. Study of the relationship between storage duration and germination percentage of seeds was studied by many researchers [6] [7] [8] [9] [10]. They arrived at equations which link the two variables through regression analysis. Walters et al. [4] determined graphically a sigmoid relationship between germination percentage and storage duration. The objective of this statistical analysis was to study the relationship between germination percentage and storage duration for each of the three species and to find out what is the model which can best fit this relationship.

II. MATERIALS AND METHODS

The experiment was conducted at the National Tree Seed Research Centre at Soba (longitude 32° 30’ E and Latitude 15° 37’ N) Sudan. The seeds of *Azadirachta indica* and *Conocarpus lancifolius* were collected from mother trees at Soba. Those of *Sterculia setigera* were collected from naturally growing trees at “El Garri” (Longitude 34° 23’ E and Latitude 11° 33’ N). The experiment included two factors; namely, storage temperature of seeds which was studied at two levels: 30 °C and 12 °C; and packing method of seeds which was studied at two levels: sealed (airtight) and perforated (ventilated) polythene bags. Each of the four combinations of the two factors was replicated four times. The time factor (duration of storage) was considered during collection of the data. The SAS statistical package was used in the ANOVA and the mean comparison.

Test which was applied to the mean comparison of the significant effect. The mean germination percentages,
averaged over all levels of packing methods and storage temperatures, were obtained against storage duration for each of the three species. Regression models of germination percent on storage duration were built for the three species. The statistical package PASW (SPSS) Version 18 for windows was used for the statistical analysis to build the regression models. Curve estimation procedure of the package was adopted.

III. RESULTS AND DISCUSSION

Effect of the treatments and their interactions

According to the ANOVA, the only significant effect on germination percentage of the three species was that of the storage duration. The finding of the mean comparisons using Duncan’s Multiple Range Test is shown in Table 1.

Table 1: Effect of storage duration averaged over all levels of temperature and packing method on germination percentage (*)

<table>
<thead>
<tr>
<th>Azadirachta indica</th>
<th>Conocarpus lancifolius</th>
<th>Sterculia setigera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (Months)</td>
<td>Mean Germination%</td>
<td>Duration (Months)</td>
</tr>
<tr>
<td>1</td>
<td>9.00a</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>4.88b</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>1.33c</td>
<td>11</td>
</tr>
</tbody>
</table>

* Means in the same column followed by the same letter are not significantly different according to Duncan’s Multiple Range Test (α=0.05)

Relationship between germination percent and storage duration

All the results showed cubic relationships between the germination percent and storage duration of seeds with significant coefficients of determination (R2). This is seen in the summary tables (Tables 2.1, 2.2 and 2.3) and the scatter diagrams (Figures 1, 2, and 3).

Table (2.1): Model Summary and Parameter Estimates

(Azadirachta indica)

<table>
<thead>
<tr>
<th>Equation</th>
<th>Model Summary</th>
<th>Parameter Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Square</td>
<td>F</td>
<td>df1</td>
</tr>
<tr>
<td>Cubic</td>
<td>967</td>
<td>9.700</td>
</tr>
</tbody>
</table>

The independent variable is Duration.
Fig.1: Relationship between germination% and storage duration (months) of *Azadirachta indica* seeds

Table (2.2): Model Summary and Parameter Estimates

(*Conocarpus lancifolius*)

<table>
<thead>
<tr>
<th>Equation</th>
<th>Model Summary</th>
<th>Parameter Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R Square</td>
<td>F</td>
</tr>
<tr>
<td>Cubic</td>
<td>.993</td>
<td>333.100</td>
</tr>
</tbody>
</table>

The independent variable is Duration.
Fig. 2: Relationship between germination% and storage duration (months) of *Conocarpus lancifolius* seeds

Table (2.3): Model Summary and Parameter Estimates

(*Sterculia setigera*)

<table>
<thead>
<tr>
<th>Equation</th>
<th>Model Summary</th>
<th>Parameter Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R Square</td>
<td>F</td>
</tr>
<tr>
<td>Cubic</td>
<td>.989</td>
<td>217.783</td>
</tr>
</tbody>
</table>

The independent variable is Duration.

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A curve showing the germination percent against time for one seed lot under constant storage conditions would be a sigmoid curve [4]. Sigmoid data can best be fit with a cubic model [11]. The foregoing two statements exactly coincide with the results of this study. The three curves of germination percent against storage duration in months which were obtained for *Azadirachta indica*, *Conocarpus lancifolius* and *Sterculia setigera*; are sigmoid. The three curves are best fitted by cubic models.

IV. CONCLUSION AND RECOMMENDATIONS

The main finding of this study is that quantification of the effect of storage duration on germination percentage of seeds could be obtained with an acceptable level of accuracy using empirical regression models.

Further research work could be conducted to:

- Study the effect of storage duration on the germination percentage other tree species of economic importance.
- Build regression models to quantify the effect of storage duration on the germination percentage of these tree species.

References

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