

Effect of A seed borer, *Bruchidiusuberatus*, associated With Viability and Germination of *Acacia nilotica* seeds, Sinnar state- Sudan

Alameldin EltijaniE Itayeb Elshibli,Elsiddig Mohamed A. Ahmed

FNC, Sennar state. Sudan.

College of Forests and Range science, Sudan University of Science and Technology-Soba, Sudan

ABSTRACT:

The study was aimed to investigate the effect of *B. uberatus* on viability and germination of *A. nilotica* seeds and count the percent of infestation on field and store . A total of ten sample plots were been taken from each of the three forest, Abujeily, Eljaaire and Jalgany forest with an area of each comprising one hectare. One kilogram were been collected from each plot of *A. nilotica* seeds randomly .The seeds collected from forest floor and standing trees on April 2019. Collected samples from the stand trees to identify the percent of the infestation on the Pods, these samples from the stand trees to identify the percent of the infestation on the pods. The study showrd that the infestation impact and decrease the seed germination number, seedling height, root length, diameter and number of leaves, the study shown that the infestation started from the field, The degree of infestation seeds by the beetle *B. uberatus* on standing trees was 11% on the pods from Abu jeily forest, 9.4 % in Eljazaire forest and 8.2% in Jalgany forest on the standing trees of collected seed whereas on the forest floor the degree of infestation by *B .uberatus*. on pods was Jalgany forest 26.8 % ,Eljazaire forest 23.7 % and Aujeily forest 22.0 % . in the store 76.4% had infested from the store samples.

Keywords : *Acacia nilotica*, *Bruchidius uberratus*, germination, viability, roots length.

Introduction:

Acacia nilotica (L)WILL dx Del.(sunt)is one of the major plantation species In the Sudan it is a tree of moderate size with dark grey brown to black rough fissured bark and straight white spines. It has yellow sweet scented inflorescences in globular heads and variable necklace, dehiscent Pubescent and dark brown to dark grey pods. Four sub species of *A. nilotica* were recognized in the Sudan and can be differentiated by their Pods: Tomontose, Nilotica, astringens and Subulata (ALamin ,1990{).

A. nilotica has bipinnate leaves which consist of 2-11 pairs of pinnae and 7-25 pairs of leaflets, ranging in number and size from 1-7x 0.5-1.5mm(Djufri2004). The kpresent study deals with *A. nilotica* subspecies tomontose which can easily be recognized by its very characteristic pods with flat, narrow and irregular constrictions between seeds and can be distinguished from sub species niloticaby the fruits (pods) which were covered with tomontose hairs or simply by its black fissured bark. Sub species tomontose is a medium size tree up to 17th meters high and 50th centimeter in diameter with rounded much branched crown. Branches are twiggy and crooked spreading irregularly and bearing light foliage. The pole stem of subspecies *tomontose* is straight ,short and cylindrical with bark flaking off into enlarged fibers scale (ALamin)

(Badi, et al, 1989), noted that firewood of *A. nilotica* tree is of excellent quality. The Pods locally known as (Garad) are valuable tannin material ,

A. nilotica thrives with a certain amount of over flooding, but mature trees are killed if inundation lasted more than eight months in the year.

A. nilotica belong to the family leguminaceae (Alamin, 1990).The legume seeds are susceptible to attack by many insects belonging to the order Coleoptera (beetles)(Southgate, 1983). one of these beetles is the seed borer type *Bruchidius uberatus*, this beetle causes similar damage to *Caryedon serratus* however it is primarily a pest of stored seeds. In Sudan and some places

B .uberatus is the primary infesting insect of *A .nilotica* seeds it is also infests a number of other seeds of *Acacia* species including *A.tortilis*, *A. mellifera*, *A. burkei*, *A. eroloba*, and *A. robusta*(EL Atta (1993).

B. uberatus (*Bruchus baudoni* Caillol) was first time reported by Peake (1953) as pest causing 60-70% or more infertility in *A. nilotica* seeds. As this beetle was found alive and multiplying in stored of *A. nilotica* Pods, it was considered to be essentially a pest of store seeds.

EL-Atta (1993) surveyed the occurrence and impact of this seed borers on *A. nilotica* seeds in the blue Nile reserved two forests near singa (wadelgizoli and dabkara). He reported higher rates of infestation in stored seeds (80-90%) caused by *B. uberatus* . The adult of *B. uberatus* lay eggs on the pods, and then the larva bore into the seeds, often completely destroying the seeds including embryo and endosperm of them hence preventing germination.

Leguminous trees species are important in social forestry and wasteland development programmes hence there is a great demand for their seeds. For rising large nursery stock huge quantity of sound seeds is required. A large number of insects belonging to the order Lepidoptera and *Coleoptera* feed on pods and seeds in nature and during storage (Peake 1953, Prevett 1967, Ernst 1990). The larva (pest of seeds) stage description under the microscope, the larva had a large dark brown to black head and three pairs of well developed thoracic legs, the larva is white, sometimes brown on the dorsal view and covered with hairs. The larva of *B. uberratus* wander for some days among the seeds probably seeking for a point of contact between the seeds to gain leverage necessary for entry into the seed.

The infestation decrease the germination of the seeds. (A. L. Robertson *et.al.*1990.), reported that of insect predators on mangrove species had significantly decrease survival 70 % and growth in height 96% and biomass 85 %. *Caryedon serratus* Olivier (*Coleoptera, Bruchidae*) is well known as a seed weevil infesting seeds of *A. nilotica* (L) Mukerji and Chatterjee 1951, (EL-atta (1993), on the Survey of damage in stored dehusked seeds that the infestation rates of dehusked seeds of *A. nilotica* stored for 3 months in sinnar, singa and Wad Madani, the survey revealed extremely high infestation rates of 87.8%, 87.6 % and 90 % of the total number of sample seeds, respectively, The overall mean infestation rate was 88.5% EL Atta (1953) reported that the infestation of *A. nilotica* seeds by *Caryedon serratus* –Oliver) is 20 % of the pods from forest floor and 10% of the pods from standing trees, EL Atta (1953).

Research problem:

The seeds of *A. nilotica* are attacked by *Bruchid* beetle, mainly *Bruchidius uberatus*, which account for (60 to 70 %) infertility in seeds (Peake, 1953 and EL-Atta, 1993)

General objective:

To study of the seed borer insect, *Bruchidius uberatus* affecting *A. nilotica* seeds viability and germination in Sudan.

Specific objectives:

1. To survey and estimate seed infested by the beetle in the field.
2. To compare between sound and infested seeds in germination.
3. To find out the percentage of infestation in the seeds stored in the room of the seed centre.

Material and method:

For this study three forests were selected from the Blue Nile area Abujeily forest, is first site of study area is located in Sinnar State on the eastern bank of blue Nile. The site lies within latitude (13°36' 6" and 13° 33' 55") North, and longitude 33° 35' 6" and 33° 36' 2" East. The total area is 991.13 feddan.

Eljzaire forest is second site of study area, is located in Sinnar forest on the eastern bank of blue Nile. The site lies within latitude (13° 2' 8" and 93° 4' 21") North and longitude (33° 57' 4" and 33° 58' 6") East, the total area is 913.07 feddan.

The third one is Jalgany forest which located in Sinnar State on the western bank of blue Nile. The site lies within latitude (12° 27' 44" and 92° 27' 8") North, and longitude (34° 13' 25" and 34° 14' 55") East, the total area is 416.04 feddan. These 3 forest selected because of the location on the north, middle and south of Sinnar State.

A total of (10) sample plots for each forest were been randomly selected from three base Nile Forests in sinnar state (Abu jeily forest, Aljzaire forest and Galgany forest). The forests sites located on Sinnar state, in the north (Abu jeily forest), middle of the state (Aljzaire forest) and the last one in the south of sinnar state (Galgany forest).

All sample plots taken are located in (Mayaa) soil site, each sample plot area is one hectare) measured by the Tape, from each hectare one (Kg) of *A. nilotica* seeds that collected randomly. The seeds collected on April 2019, it is the time that the *A. nilotica* seeds are mature and ready for collection. Each sample plot seeds kept in separate bag

and lable was put in each bag . At first are taken samples from Abujeily forest, all the (10) samples collected from this forest kept in one box.

Another (10) samples are taken from the stand trees from the same sample plots and kept separately in a bags and in deferent box, these samples from the stand trees to identify the percent of the infestation on the Pods which are still not fall from the trees.

The next forest is Aljazaire forest,the same method for collecting samples done in Abu jeily forest also done in this forest and also in last forest Galgany. The samples collective from the floor and from the trees, each samples kept separately.

. The infested seeds from the stand trees kept separately to identify the correct percent of the infestation from each sample.

The germination was done in Sinnar circle nursery at Sinnar forest office .By using hand lens (50)infested seeds selected from each forest from the (10) samples of seed collected from the floor and (50) sound seeds selected from the samples of seed collected from the floor, the infested seeds and sound seeds kept separately for each forest .

To break the seeds dormancy treatment done by using sulphuric acid on concentrate (98%)(Wunder, 1966). The treatment done separately for the selected seeds(sound and infested) . The treatment done in a glass bottle by adding (5CC) to seed on the bottle, the acid took by injection, then stir the seeds on the acid for 30minute ,on the end washing the seed by water and left them to dry .The next phase is to prepare polyethylene bags ready by bagging them by the nursery soil we have 300 bags all the bags putted in one nursery basin and kept space between each (50) bags Before sowing the seed I fixed a label to identify each treatment, from each forest we have (50) sound seeds and (50)infested seeds, forest number one is Abu jeily ,the label of the (50) sound seeds label identify by the capital letter (S_1) and the (50)infested seeds label identify by the capital letter (I_1).The second forest is Aljazaire forest the (50) sound seeds label identify by capital letter (S_2)and the (50) infested seeds label identify by the capital letter(I_2)the last forest is Galgany, the (50) sound seed label identify by the capital letter (S_3) and the (50) infested seeds label identify by the capital letter (I_3).The seeds sowed on the date 8/may/2019.the irrigation done two time/week ,number of germination recorded weekly for a month to the both sound and infested seeds and quantified as viability percentage .The germination percentage, seedling traits in nursery were recorded for Plant survival percentage (after1 and 3month),seedling height in(cm),collar diameter (in mm),number of leaves per plant ,above and below ground biomass and total biomass (g/ seedling) at the end doing comparing between the infested and sound seeds then measured heights and diameter of the shoot.

Surveying of the damaged done by collecting one (100seeds) from the samples on each forest, for Abu jeily forest collective (100) seeds from the (10) sample which were collected from the floor and (100) seeds from sample collected from the trees to count the number of seeds infested by *B. uberatus* by using hand lens and count the percentage for the infestation for the forest and the same way was done in *Aljazaire* and *Galgany* forest. A total of 7 samples were taken from 10 sacks of *A. Nilotica* dehusked seeds in Sinnar forest office store to survey the damage in the store, each sample One Kg, from each sample 100 seeds selected randomly and examined carefully for entrance and adult insect exit hole with the aid of hand lens.

Data analysis using the SAS satirical programme

Results:

Generally the result revealed significant differences between the sound and infested seeds on the germination, seedling height, diameter, number of leaves and root length.

Effect of sound and infested seed on seedling height:

The result revealed significantly differences between the Sound and Infested seeds on the seedling height.(Table 1), 12.4 a recorded as higher height of sound seed from Jalgany forest whereas 3.5 d recorded as a lower height of infested seed from Jalgani forest(table 2) .

differences between the Sound and Infested seeds on the seedling height.(Table 1)

Table (1): Effect of sound and infested seeds on seedlings height

| Sources | D.F | S.S | M.S | F. VALUE | P |
|---------|-----|-------|--------|----------|-------|
| Model | 5 | 559.3 | 111.82 | 19.5 | .0001 |
| Error | 47 | 268.6 | 5.7 | - | - |

C.V 31.4%

Table (2): Effect of status of the seed on height

| Seed and forest | Mean |
|--------------------------------------|--------|
| Sound seeds from Jelgany forest | 12.4 a |
| Sound seeds from Abu jeily forest | 11.9 a |
| Sound seed from Eljazair forest | 9.4 a |
| Affected seeds from Eljazaire forest | 6.3 c |
| Affected seeds from Abujeily forest | 5.9 c |
| Affected seeds from Jalgany forest | 3.5 d |

Means with the same letter are not significantly different

Effect of sound and infested seeds on the Diameter:

The result revealed significantly differences between the sound and infested seeds on the seedling Diameter.(Table 3), 1.3 a recorded as higher Diameter measured of sound seed from Abujeily forest whereas 0.5 d recorded as a lower Diameter measured of infested seed from Jalgani forest(table 4).

Table (3) :differences between the Sound and Infested seeds on the seedling Diameter.

| Sources | D.F | M.S | S.S | F. value | P |
|---------|-----|-----|-----|----------|-------|
| Model | 5 | 4.9 | .9 | 75.4 | .0001 |
| Error | 47 | .6 | .01 | - | - |

C.V 12.4 %

Table (4) :Effect of status of the seed on diameter

| Seeds and forest | Mean |
|--------------------------------------|-------|
| Sound seed from Abujeily forest | 1.3 a |
| Sound seeds from Jalgany forest | 1.3 a |
| Sound seeds from Eljazaire forest | 1.2 b |
| Affected seeds from Eljazaire forest | 0.7 c |
| Affected seeds from Abujeily forest | 0.7 c |
| Affected seeds from Jalgany forest | 0.5 d |

Means with the same letter are not significantly different.

Effect of sound and infested seed on the number of leaves (NOL)

The result revealed significantly differences between the Sound and Infested seeds on the seedling (NOL).(Table 5), 15.1 a recorded as higher number of leaves on sound seed from Abujeily forest, whereas 4.5 c recorded as a lower number of leaves on the infested seed from A bujeily forest. (table 6).

Table (5) :different between the Sound and Infested seeds on the seedling

| Sources | D.F | S.S | M.S | F. value | P |
|---------|-----|-------|-------|----------|-------|
| Model | 5 | 854.1 | 170.8 | 35.5 | .0001 |
| Error | 47 | 225.8 | 4.8 | - | - |

C. V 21.9 %

Table :(6)Effect of the status of the seeds on(NOL)

| Seeds and forest | Mean |
|-------------------------------------|--------|
| Sound seeds from Abujeily forest | 15.1 a |
| Sound seeds from Jalgany forest | 14.8 a |
| Sound seeds from Eljazaire forest | 14.2 a |
| Affected seed from Eljazaire forest | 8.0 b |
| Affected seeds from Jalgany forest | 7.3 b |
| Affected seeds from Abujeily forest | 4.5 c |

Means with the same letter are not significantly different.

Effect of sound and infested seed on root (R):

The result revealed significantly differences between the Sound and Infested seeds on the seedling root length.(Table 7), 12.7 a recorded as higher roots length on sound seed from Jalgany forest, whereas 7.5 d recorded as a lower roots length on the infested seed from Eljazaire forest. (table 8).

Table (7) :differences between the Sound and Infested seeds on the seedling root length.

| Sources | D.F | S.S | M.S | F.value | P |
|---------|-----|-------|------|---------|-------|
| Model | 5 | 236.2 | 47.2 | 37.2 | .0001 |
| Error | 47 | 59.6 | 1.2 | - | - |

C.V 10.8 %

Table (8) :Effect of status of the seed on the length of the root (R)

| Seed and forest | Mean |
|--------------------------------------|--------|
| Sound seed from Jalgany forest | 12.7 a |
| Sound seeds from Eljazaire forest | 12.7 a |
| Sound seeds from Abujeily forest | 12.6 a |
| Affected seeds from Abujeily forest | 10.8 b |
| Affected seeds from Eljazaire forest | 9.0 c |

Affected seeds from Jalgany forest 7.5 d

Means with the same letter are not significantly different.

Effect of sound and infested seed on germination :

The result revealed significantly differences between the sound and infested seeds, (table 8 and table 10). Considerable failure of germination occurred in the infested seed in reference to sound ones. The difference on germination is 26.6 a recorded as higher number of germination on sound seed from Abujeily forest whereas 4.0 c recorded as a lower number of germination on sound seed from Jalgany forest (table 9). The difference on germination is 18.6 a recorded as higher number of germination on infested seeds from Eljazeera forest whereas 1.3 b recorded as a lower number of germination on infested seed from Jalgany forest (table 10).

Table (9) :Differences of germination in the infested seeds:

| Source | D.F | S.S | M.S | F. value | P |
|--------|-----|-------|-------|----------|--------|
| Model | 4 | 785.7 | 196.4 | 19.75 | 0.0067 |
| Error | 4 | 39.7 | 9.9 | - | - |

C .V 19.4 %

Table (10) :Effect of status of seed on germination

| Forest and germination | Mean |
|-----------------------------------|--------|
| Sound seeds from Abujeily forest | 26.6 a |
| Sound seeds from Eljazeera forest | 18.0 b |
| Sound seeds from Jalgany forest | 4.0 c |

Means with the same letter are not significantly different.

Table (11) :Differences of germination on sound seeds :

| Source | D.S | S.S | M.S | F.value | P |
|--------|-----|-------|-------|---------|-------|
| Model | 4 | 516.4 | 129.1 | 14.1 | .0125 |
| Error | 4 | 36.4 | 9.1 | - | - |

C. V 33.9%

Table (12) :Effect of status of seed on germination:

| Forest and germination | Mean |
|--------------------------------------|--------|
| Infested seeds from Eljazeera forest | 18.6 a |
| Infested seeds from Abujeily forest | 6.6 b |
| Infested seeds from Jalgany forest | 1.3 b |

Means with the same letter are not significantly different.

Survey of damage in the forests (Pods from trees):standing:

The seeds infestation by *Bruchidiusuberatus* larvae on the 3 forest are not more significantly difference (0.1565)table 13, The difference on infestation is 11.0 a recorded as higher number of infestation of seeds from Abujeily forest whereas 8.2 a recorded as a lower number of infestation on seed from Jalgany forest (table 14).

Table (13) :Differences of the infestation on pods from standing trees:

| Sources | D.F | S.S | M.S | F.value | P |
|---------|-----|-------|------|---------|--------|
| Model | 2 | 39.4 | 19.7 | 1.9 | 0.1565 |
| Error | 27 | 268.0 | 9.9 | - | - |

C .V 33.0 %

Table (14):Number of infestations on pods from standing trees:

| Pods and forest | Mean |
|----------------------------|--------|
| Pods from Abujeily forest | 11.0 a |
| Pods from Eljazeera forest | 9.4 a |
| Pods from Jalgany forest | 8.2 a |

Means with the same letter are not significantly different.

Survey of damage in the forests (Pods from forests floor):

The seeds infestation by *B.uberatus* larvae on the 3 forest are not more significantly difference (0.1502)table 15, The difference on infestation is 26.8 a recorded as higher number of infestation of seeds from Jalgany forest whereas 22.0 a recorded as a lower number of infestation on seed from Abujeily forest (table 16).

Table (15) :Differences of infestation on pods from forests floor:

| Sources | D.F | S.S | M.S | F.value | P |
|---------|-----|-------|------|---------|--------|
| Model | 2 | 118.4 | 59.2 | 2.0 | 0.1505 |
| Error | 27 | 785.7 | 29.1 | - | - |

C .V 22.3%

Table (16) :Number of infestation on pods from forests floor (table 15):

| Pods and forest | Mean |
|----------------------------|--------|
| Pods from Galgany forest | 26.8 a |
| Pods from Eljazeera forest | 23.7 a |
| Pods from Abujeily forest | 22.0 a |

Means with the same letter are not significantly different.

Table 14 and table 15 summarise the results of seed infestation by *B. uberatus* larvae in Abujeily, Eljazeera and Galgany forest respectively, the infestation rate was greater in pods on the forest floor than the pods from standing trees.

Survey of damage in the store seeds:

The infestation rate for seeds of *A. nilotica* stored for three months in Sinnar store for (7) samples is 76.4%, it is an extremely high infestation rate. The result is relevant to AL Atta, H. A., 1993. In the stored seed of *A. nilotica* infested by a seed borer *Caryedon serratus*, the study shown mean infestation rate was 88.5%

Discussion:

Bruchidius uberatus larvae bore into the seed of *Acacia nilotica* trees and will never leave the seed unless become an adult, so it will consume the embryo and endosperm, hence the seed will never germinate because it was hollowed but if the larvae did not complete the cycle and there is no an adult emerging hole maybe the seed will germinate, the present study has shown that the failure in germination of *A. nilotica* seeds was not happened because of the improper fencing against animals, insufficient flooding and bad quality of seeds, a seed which bore by *B. uberatus* larvae and complete the cycle will never germinate. The infestation rate was extremely high in stored seeds (76.4%). Peake (1953) reported *B. uberatus* as a pest causing (60- 70 %) or more infertility in *A. nilotica* stored seeds, so it was considered to be essentially a pest of stored seeds. The study shown that the infestation has started from the field. The degree of infestation seeds by the beetle *B. uberatus* in standing trees was 11% on the pods from Abu jeily forest, 9.4 % in Eljazeera forest and 8.2% in Galgany forest, whereas the infestation was 76.4% in the seeds which stored. the degree of infestation on pods from forest floor was Galgany forest 26.8 %, Eljazeera forest 23.7 % and Abujeily forest 22.0 %. EL Atta (1953) reported that the infestation of *A. nilotica* seeds by *Caryedon serratus* –Oliver) is 20 % of the pods from forest floor and 10% of the pods from standing trees. The study shown that infested seed by *B. uberatus* insect impact on seedling growth by decreasing seedling height, diameter, number of leaves and root length the differences were significantly, (.0001). The infestation decrease the germination of the seeds. (A. L. Robertson *et.al.*1990) reported that of insect predators on mangrove species had significantly decrease survival 70 % and growth in height 96% and biomass 85 %. The infestation decrease the germination of seed of *A. nilotica* tree. In comparison between *B. uberatus* and *Caryedon serratus* has revealed that seeds damage by *Bruchidius uberatus* can be distinguished from damage by *Caryedon serratus* by the regular round emergence holes of the adult *Bruchidius spp.* compared by the smaller and irregularly shaped exit holes of the fully developed *Caryedon serratus*. (EL Atta. H. A.(1993).

Conclusion :

The infestation of *Bruchidius uberatus* insect on *Acacia nilotica* seeds had many influences on the seedling growth but it had no impact on survival of infested seed when germinated, although its impact on seedling height, germination, root length and number of leaves but it take long time in the nursery beds and increasing the cost. The study shown that the infestation started from the field and then transfer to the store. Spraying or dusting of mature sun forest to prevent initial attack in the green pod is clearly impracticable and this original infestation must be taken as a necessary evil. The pods, by the time they are collected from the forest floor, will already be infested by beetles. To obtaining the failure in germination and losses of heavy amounts from different forest tree species needs better understanding of seeds genetics, collection, storage, processing, marketing and its legislation. Seed industries are now also gaining the market entries and are important source of employment.

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