Effect of Habitats on the Tree Locust *Anacridium Melanorhodon Melanorhodon* (Walker) on Sexual Maturationin North Kordofan State, Sudan

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Abstract:-The tree locust, Anacridium melanorhodon melanorhodon (Walker, 1870) (Acrididae: Orthoptera), has been known to cause sporadic damage mainly to trees. In Sudan, it is called night wanderer (Sari El Lil) because of its nocturnal activity. It is commonly found on the Sudanese western sand, causing substantial damage to the gum arabic producing Acacia senegal (Hashab) trees. This study was carried out during 2007/08 and 2008/09. Field work was done at an Acacia senegal plantation of the Acacia Project (Elrahad) site, 57 km south east of El Obeid city, North Kordofan State. Laboratory experiments were done at The Gum Arabic Research Centre, University of Kordofan. The objectives of the study were to investigate the factors that influence the tree locust population movements and distribution in the Elrahad site, North Kordofan State. These factors were behavior and food intake. The results showed that development ovarioles acquired when females of tree locust fed in Acacia senegal, Balanitesaegyptiaca, Pennisetumtyphoides and Sorghum bicolor and the highest developments in Acacia senegal, they were (188.25 and 192.61) in the first and second oocytes, respectively.Food type was found to have an effect on fecundity of tree locust's females, different types of habitat is effect on ovary developmentand female oviposition.

Keywords:-Anacridiummelanorhodonmelanorhodon female, food types, Effect.

I. INTRODUCTION

Anacridium melanorhodon melanorhodon, common names: - tree locust, Sahelian tree locust and Sudan tree locust.Thearabic name is Sari El Lil (night wanderer) [11], [7] and [12]. According to [6] there are four species under the sub-genus, Anacridium : A .melanorhodon, A. moestum, A. wernerllum and A. aegyptium. According to [19], Walker describedAnacridiumunder the name Anacridium melanorhodon melanorhodon, from the Cape Verde Island in1870. The species A. melanorhodon is divided into two subspecies, Anacridium melanorhodon melanorhodon (Walker, 1870) and A. m. arabafrum (Dirsh, 1953). According to [6] there are other identified species of the genus Anacridium:A. wernerellum(Karny.), A. aegyptium(Linnaeus), A. moestium(Serville), A. incisium (Rehn), A. burr (Dirsh), A. rehn (Dirsh), A. eximium (Sjostedt), A. illustrissimum(Karsch), A. rubrispinum(Bei-Bienko), A. flavescens(F)and A. arabicum (Uvarov).

The genus Anacridium is disseminated on the African continent with the noticeable exception of the Congo high rain forest. Nevertheless A. m. melanorhodon is regarded as a northern species in Africa while A. wernerellum occurs in the south [6]. [15], [6], [21] and [19] reported that A. m. melanorhodonoccured in Cape Verde Island, Senegal, Mauritania and Morocco. [18] and [19] reported it in Mali, Nigeria, Niger, Chad, and Ethiopia. [26],[19], [9] and [24] reported the occurrence of A. m. melanorhodon in Eritrea and the Red Sea coast of Sudan A. m. melanorhodon and the subspecies A. arabafrum overlap in eastern Sudan and western Eritrea [2]. The distribution of Anacridiumaccording to [6] is between latitudes 4°N to 20°N, while A. m. melanorhodon is confined between lat. 12°N and 20°N. According to [23] there was a build up of tree locusts in unprecedented numbers, infesting from 20,000 ha in 1987 to over 1 million hectares in late 1989, despite considerable control efforts, especially in the gum arabic belt The gum arabic belt (lat.10°-14°N), receives an annual rainfall of 280-450mm. The belt extends through Kordofan, Darfour, Kassala, Gadarif, Blue Nile and Upper Nile States and covers about 3600000 hectares[13], [3] and [4]. [17]mentioned that A. senegal plays an important part in the balanced agricultural practices as well as in the socio-economic set-up in Kordofan where the farmers have realized the multifarious benefits of the hashab tree. It provides them with gum, enriches the soil fertility as its roots fix nitrogen in the soil, and prevents run-off and soil erosion. It protects agricultural fields from the shifting sand and desiccation, and it provides farmers with additional incomes in the form of building materials, materials for agricultural implements, fire wood and charcoal. Tree locusts attack the flowers of mango, citrus and guavas, and in the case of the latter, they also feed on the leaves. They feed on vegetables and most field crops, and in 1989 they, together with grasshoppers, replaced desert locusts as the farmer's main cause for concern [23]. It is not known what factors triggered this build up, nor what natural controls will ultimately reduce the population back to recession levels. Tree locust's populations in Chad and Ethiopia were remarkably high, and in the latter

country they were expected to reduce fodder and pasture [23].

Habitat and host range of tree locusts are usually found in open woodland in the middle of thorny trees and shrubs. Tree species attacked include Acacia spp., Mytenussenegalensis and Balanitesaegyptiaca. In the high rainfall area to the south their range extends a short distance into the savanna zone. In the northern part of Sudan, which is an arid region, tree locusts appear mainly in irrigated areas along water courses. Natural food plants comprise various tree species like Acacia senegal, A. nubica, A. mellifera, A. tortilisand A. seyal[14], [26], [22], [1] and [10]Zizyphus sp. and Caparisdeciduas[16] and [7]. A broad range of crops is attacked by tree locusts; which include, vegetables and field crops such as cotton and sorghum [22] and [23]. Other attacked crops include cowpeas, peanuts, tobacco, maize, millet watermelon and rice [20], natural and planted forests [5], [25], [12] and [23]. The mobility of locust swarms enables them to invade all areas in Sudan except the high rainfall regions in the south, and the desert in the north. The various economically important locusts and grass hoppers species are normally confined to the Sahelian semi arid and arid acacia savannah. Tree locusts, as their name implies, favors the more heavily wooded acacia savannah, and during the dry season, the acacia belt along the Nile. The distribution of tree locusts is closely related to that of Acacia senegal and A. seyal. These trees occur mainly between latitudes 10° N and 15° N. This region embraces the gum belt, and is dominated by various species of Acacia, mainly A. senegal on sands, A. seyal, on areas of poor drainage, and A. mellifera on the more alkaline clays. On the drier 'goz' sands, Leptadeniapyrotechnica is a frequent bushy constituent. On the heavier dark cracking clay vertisols, where rainfall increases to 600 mm, Balanitesaegyptiaca, various Combretum spp., and Ziziphusspina christi form a substantial element in the tree population. Trees are an important constituent of the diet of cattle, goats and camels, but not of sheep. Green foliage, and fallen pods and leaves, provide high protein supplements to grass, whose protein content drops below maintenance level for livestock in the dry season. During droughts, or where overgrazing has eliminated range grasses and herbs, acacia branches are cut to make the foliage accessible. Defoliation of trees by tree locusts can have severe negative consequences for livestock production, in addition to decreasing gum arabic yields [23].

There are two main ecological sub divisions within it, the clay and the goz sand areas. On the clays, Acacia mellifera forms dense thickets in the drier areas, but in the wetter southern sector (550 800 mm) it is replaced by the red stemmed A. seyal[23]. This is a gum producing species, but not as valuable as A. senegal. It is often associated with Balanitesaegyptiaca, which is widely conserved for its edible fruits and good shade. However, the rising demand for charcoal results in the felling of this species as also is the expanding need for it as furniture wood. The pale stemmed gum arabic tree, Acacia senegal, is dominant on the drier goz sands in areas with 300 450 mm rainfall, and has been a major source of income. The gum arabic trees are now severely depleted in many areas, having been felled for charcoal or expansion of arable lands. In Darfur (south and east) a belt of over 100 km wide of former savannah is now a sheet of moving sand. A similar process is occurring in the area south of El Obeid in Kordofan[23]. Defoliation of hashab trees by the tree locust had significantly ($P<0.01$) reduced gum arabic yield. Loss in gum yield was negatively correlated ($r = -0.89$) with the intensity of defoliation [8].

II. MATERIALS AND METHODS

Adults of tree locust males and females were collected from the field at the end of April during (2007/08 and 2008/09). Ovarioles of some females were found to be mature; such adults were collected and placed in cages. The floors of the cages were covered with moist sand up to 20cm. Sixteen cages, each having 10 pairs were prepared. The cages were divided into groups of four and each group was provided with a different type of food. One set of cages was provided with branches and leaves of Balanitesaegyptiaca; another with new branches and leaves of Acacia senegal and the third group with sorghum Sorghum bicolor seedlings and crushed sorghum grains and the fourth group with milletPennisetumtyphoides seedlings and crushed millet grains. The females were left in the cages until they laid eggs and died. All dead females were dissected to assess the development of the ovary in each type of food. Data were analyzed by the descriptive statistics method (SPSS).

III. RESULTS

Effect of type of food on number of ovarioles

Table (1) shows the mean number of ovarioles in ovaries of females fed on different types of food. There appeared to be some differences between the food types, but the differences were not significant. Acacia senegal gave slightly higher mean number of overioles.

Table1. Mean number of ovarioles in ovary of female fed on different types of food (seasons 2007/2008 and 2008/2009)

Feeding type	*Mean of eggs\ovary	Std. error ±	Std. deviation ±
Balanitesaegyptiaca	186.20c	1.12	2.05
Acacia Senegal	190.54a	1.12	3.08
Sorghum bicolor	188.84b	1.12	3.61
Pennisetumtyphoides	186.48c	1.12	3.71

*Means within the same row followed by the same letter are not significantly different at p<0.05.

The effect of food on egg yolk development

Egg yolk development in the first oocyte

Table (2) shows the development of egg yolk in the first oocyte ovarioles. When females fed on Pennisetumtyphoides,Balanitesaegyptiacand Acacia senegalthey laid egg (white body), but when they fed on Sorghum bicolor most of the developing eggs in the first oocyte were resorption and ovarioles gave more red body. Feeding on sorghum significantly (P=0.001) hampered production of sound eggs.

Table 2. Mean of egg yolk development in the first oocyte of ovariole of female tree locust, fed on different types of food.

*Mean of egg yolk condition in 1st oocyte		
Types of food	Complete egg	Red body
Balanitesaegyptiaca	188.65 ± 2.73a	182.04 ± 1.95c
AcaciaSenegal	188.25 ± 2.73a	191.11 ±1.95a
Sorghum bicolor	72.80 ± 2.73c	188.66 ±1.95b
Pennisetumtyphoides	93.78 ± 2.73b	186.80 ±1.95bc

Egg yolk development in the second oocyte

Table (3) shows the development of egg yolk in the second oocyte of ovarioles. When females fed on Pennisetumtyphoides,Balanitesaegyptiacaand Acacia senegalthey laid more eggs (white body), but when they fed on Sorghum bicolor most of the developed eggs in the second oocyte were resorption and ovarioles produce red body.

Table 3. Percentage of egg yolk in the 2ndooceyte of ovariole of female tree locust, fed on different types of food.

Egg yolk condition in 2nd oocyte	*Men of egg yolk development/female			
	Balanitesaegyptiaca	Acacias enegal	Sorghum bicolor	Pennisetumtyphoides
Complete egg	186.03 ± 2.15b	192.61 ±2.15a	142.06 ±2.15c	48.40 ±2.15d
Red body	68.16 ±3.32c	71.03±3.32c	139.44 ±3.32a	90.0±3.32b

*Means within the same row followed by the same letter(s) are not significantly different at p<0.05.

Egg yolk development in the third oocyte

Table (4) shows the egg yolk development in the third oocyte of ovarioles. When females fed on Acacia senegal23.6% of them laid eggs compared with other type of food plants, but when they fed on Balanitesaegyptiaca, Sorghum bicolor and Pennisetumtyphoides the third oocyte of ovarioles were resorption and failed to produce eggs.

Table 4. Percentage of egg yolk development in the 3rdooceyte of ovariole of female tree locust, fed on different types of food.

Egg yolk condition in 3rd oocyte	*Mean of egg yolk development			
	Balanitesaegyptiaca	Acacia senegal	Sorghum bicolor	Pennisetumtyphoides
Completed egg	0.0 ±2.40c	0.0 ±2.40c	49.51 ±2.40b	93.55 ±2.40a
Red body	0.0 ±2.36b	0.0 ±2.36b	68.96 ±2.36a	67.91 ±2.36a

*Means within the same rowfollowed by the same letter(s) are not significantly different at p<0.05.

IV. DISCUSSION

Different types of food A. senegal, , P. typhoides,B. aegyptiacaand S. bicolor there was variation on the percentage of eggs produced by female it were 81.8%, 76.3%, 60.8% and 39.6%, respectively. The results showed that there was one egg pod/female produced in the second oocyte and it was more than other oocytes when fed on A. senegal, this agreed with Evans and Bell, (1979) who mentioned that the leaves of Acacia species have been found to contain amino acid, and hopper of Anacridiummelanorhodon, feed on the leaves of Acacia species, prefer them more than other host plants. Burton et al., (1972) and Sanonet al, (2005), mentioned that;Pearl millet, P. typhoides and S. bicolor grains were very rich in protein and oil content than other cereal crops and the leaves of B. aegyptiaca have higher minerals content.

REFERENCES

[1] Abdalla, A.A. (1990). The situation of desert locust, tree locust and grasshoppers in the Sudan (1990-1991) in Lomer, C. J.; Prior, C.: Eds. Biological control of locusts and grasshoppers. p. 97-98, ISBN 0-85198-779-6 (1992).

[2] Anonymous (1976) Pest: Anacridiummelanorhodon (Wlk.) (including A. m arabafrum Dirsh) (Rosholt.,Acrididae) (Sahelian tree locust) Distrib. Maps Insect PestsCommon Wealth Institute of Entomology, 355, pp.

[3] Awouda, E. M. (1974). Gum Arabic its present and future. Gum Arabic Company report, 1974, Khartoum -Sudan. Government Press, PP 15 - 21.

[4] Badi, K.H. (1989).The Forests of the Sudan. Agricultural Research Council. Khartoum. May 1989.

[5] COPR, (1982).The locust and Grasshopper Agricultural Manual, London, Centre for Overseas Pest Research, vii + 690 PP.

[6] [6] Dirsh, V. M. and Uvarov, B.P. (1953). Tree Locusts of the genus Anacridium (Orthoptera, Acrididae).(Revisal Espanola de entomologic), 29: 7-69.

[7] El Amin, H. M. A., (2007). The Effects of Tree Locust Anacridium melanorhodon melanorhodonon Gum Arabic Production and the Consequences of Defoliation for the Producers.M.Sc,Forest Trop Faculty of Forest Geo and Hydro Sciences Instiute of Forest Production Dresden University of Technology Germany.

[8] El Atta, H.A. and El Bashier, E. M. (1995). The Effect of Tree Locust Defoliation on Gum Arabic Production by Hashab Trees (Acacia senegal) in the Sudan.University of Khartoum Journal of Agricultural SciencesVol. 3, No. 2, 1995. pp:3 (2), 111-121, 15 Ref.

[9] El Tahir, B. A. and Gebauer, J. (2004). Non-timber Forest Products: Opportunities and Constraints for Poverty Reduction in the Nuba Mountains, South Kordofan, Sudan. Conference on International Agricultural Research for Development.Deutscher Tropentag 2004.Berlin, October 5-7, 2004.

[10] ELZain, ELB, (1994)The Impact of Defoliation by the Tree locust, Anacridiummelanorhdonmelanorhodon, on the Gum Arabic Production by Hashab Tree Acacia Senegal M.Sc. Thesis, Faculty of Agriculture, University of Khartoum.

[11] Emms, C. and Barnett. L.K. (2006). Gambian Biodiversity:A Provisional Checklist of all Species Recorded within The Gambia, West Africa.Report, May (2005) pp.14.

[12] FAO. (2007). Forest Health and Biosecurity Working papersFBS/31E, over view of forest pests Sudan. FAO.

[13] Johnston, H. B. (1924). A note on locust, Sudan Notes and Records, 7:91-101.

[14] Johnston, H. B. (1932). Notes on tow locusts of minor economic importance in the Sudan.Bull. Ent. Res. 23:49-64.

[15] Keith, J. O. and Plowes,D. C. H. (1997).Considerations of Wildlife Resources and Land Use in Chad, Productive Sector Growth and Environment Division Office of Sustainable Development. Bureau for Africa.Technical Paper No. 45March 1997.

[16] Meinzingen, W. F. (1993).A Guide to Migrant Pest Management in Africa. FAO.AGP, Viadelle Terme di Caracalla. 00100 Rome, Italy.

[17] Muthana, K. D. (1988). Gum Arabic - the Back Bone of Kordofan Region, Sudan.Mysforest; 24: (2).95-98.

[18] Nickerson,B.(1962).Some observations on the biology of the tree locust (Anacridium m.melanorhodon Walker (Orth., Acrididae)) in West Africa.TheEntomologist's MonthlyMagazine 98, 107 (1962).

[19] Popov, G.; and Ratcliffe, M.(1968): The Sahelian tree locustAnacridiummelanorhodon (Walker) Anti-Locust Memoirsno. 9, 45.

[20] Risbec, J. and Mallamaire, A. (1949).Les animauxprédateurs et les insectes parasites des riz cultivés en Afrique Occidental AgronomieTropical4, 70-76 (1949).Natural Resources Institute,University of Greenwich.297.

[21] Schmutterer, S. P. and Koch,C.K. (1978). Thepeststatus of Orthopt era in the Cape Verde Islands. Journal of Applied Entomology 86, 320-336 (1978).

[22] Schmutterer, H. (1969), Pests of Crops in North-east and Central Africa with particular reference to the Sudan. Stuttigart Gustav Fischer Verlag, Portland-U. S. A.,X + 296 PP.

[23] SEA. (1990). Supplemental Environmental Assessment (SEA) for USAID Funding of Locust or Grasshopper Pesticide in Sudan. USAID Khartoum October 1990.

[24] Showler,A.T. (1995).Locust (Orthoptera: Acrididae) outbreak in Africa and Asia 1992- 1994. An overview AmericanEntomologist 41 (3), 179-185 (1995).

[25] Steedman, A. (1987). Locust Hand Book. Over Sea Development Natural Resources Institute. The Scientific Unit.Administration.

[26] Tigani, M. H. (1965). Biology of PoecilocerusheiroglyphicusKlug.and tree locusts of the genus Anacridiumin the Sudan M.Sc. Thesis, Khartoum University. and Uses of Common Trees and Shrubs of Dry land Sudan. Entomological Society of America. Annual meeting 0242 (2006) pp.167.