



Population Dynamics of *Dysdercus volkeri* F. (Heteroptera: Pyrrhocoridae) at Different Stages of Cotton Development in Northeastern Nigeria

¹Dunuwel, D. M., ²Malgwi, A. M., ²Medugu, M. A. and ³Degri, M. M.

¹Department of Horticultural Technology, Federal College of Horticulture Dadinkowa, Gombe State, Nigeria

²Department of Crop Protection, Faculty of Agriculture, Modibbo Adama University, Yola, Adamawa State, Nigeria

³Department of Agronomy, Faculty of Agriculture, Federal University of Kashere, Gombe State, Nigeria

Abstract

Two-location field trials were conducted at the Teaching and Research Farm of the Department of Crop Protection, Modibbo Adama University of Technology Yola and at the School Farm Government Girls Secondary School Kaltungo, Gombe state, in 2022 cropping season. The study was carried out to determine the population dynamics of *Dysdercus volkeri* at different stages of cotton development in North-Eastern Nigeria. The experiments were laid-out using randomize complete block design (RCBD) and the treatments consisting of five cotton varieties (SAMCOT 8, SAMCOT 9, SAMCOT 10, SAMCOT 11, SAMCOT 12) were replicated four (4) times. The week that had the highest population of *D. volkeri* in a combined analysis was 18 Weeks After Sowing (WAS), 66.30 in Yola and 16WAS, 20.70 in Kaltungo, per 10 cotton plants. The least population of the insect in both locations was obtained on 12WAS with 27.70 in Yola and 12WAS with 2.83 in Kaltungo, per 10 cotton plants. SAMCOT 10 had the highest population of the insect in both location with 54.71 and 32.70 (per 10 cotton plants) with the least on SAMCOT 11 and 12 with a population of 37.17 and 7.57 (per 10 cotton plants). Boll maturation stage supported the highest population of *D. volkeri* at Yola and Kaltungo with 89.23, the least at the beginning of boll formation 48.34 in both locations.

Keywords: Population; Cotton Stainer; Dynamics; Boll; *Dysdercus volkeri*

*Correspondence email:
dunuweldanzariamusa@gmail.com
ORCID: 0009-0004-4578-1354

INTRODUCTION

Cotton (*Gossypium* spp F.) is one of the most important cash crops in Nigeria. The crop is grown by about 0.8 million farmers on a total estimated area of 6000-7000 ha and ranked second to groundnut as cash crop of the North (Adeniji *et al.*, 2007). Cotton has made

substantial contribution to government revenue through taxes and export. It also provides employment to many farming households, granaries and raw materials for textile industries. In addition, cotton seeds provide edible oil for human consumption while cotton seed cake is used as raw material for livestock feed because of its high protein content (Idem, 1999; Ogunlela, 2004; Malgwi and Onu, 2011). There is contradiction about the origin of cotton; it is debatable whether they were developed in

America, China or India (USDAERS, 2013). In 2012, production totaled 17.3 million bales, with 12.3 million acres planted. The average price was \$0.71 per pound with a crop value of \$5.97 billion (USCP). A report published in May 2012 by the USDA National Agricultural Statistics Service ranked the highest cotton – producing states as Texas, Georgia, Arkansas, Mississippi, North Carolina, Tennessee, Arizona, Missouri, Alabama, California, South Carolina and Louisiana (CCRI, 2011). The cottons that were first cultivated in Africa reached the continent from Asia, and were of four kinds, that spread in three separate zones and that were introduced at different times. The evolution of the true cottons of the Old World has been along two lines, one leading to the differentiation of *G. arboreum* from *G. herbaceum*, and the other to the formation (CFWWF, 2016).

The cultivation of special crops for hand-processing tends to die out in areas of commercial production, partly because, for the reasons mentioned above, it is more or less actively discouraged, and partly because in such areas the local cloths cannot stand up to the competition of the cheap machine-made cloths that can be bought with the proceeds of the sale of cash crops (Yafa, 2013). There are no reasons to regret the passing of hand-ginning and hand-spinning, which are tedious and time-wasting, but some of the fabrics produced, such as the so-called Kano cloth of northern Nigeria and the Damour of northern Sudan, are serviceable and durable, and the patterned cloths of parts of southern Nigeria and Ghana have traditional and ceremonial uses. It should not be impossible, by making available machine-spun yarn, to preserve the craft of hand-weaving while eliminating the undesirable hand-spun cotton crop (Malgwi, 2007; Idris, 2015).

MATERIALS AND METHODS

Study Area

This was a multi-locational experiment conducted at Yola, Adamawa State and Kaltungo, Gombe State during the 2022 cropping season. Yola field trial was conducted at the Teaching and Research Farm of the Department of Crop Protection, Modibbo Adama University, Yola. Yola is located in the Northern Guinea Savannah Ecological zone of Nigeria within latitude 9° 10' N to 9° 19' N and longitude 12° 20' E to 12° 35' E with the area of 1,213.3Km² at an altitude of 158.5m. The mean annual rainfall is between 900mm and 1100mm. the annual minimum and maximum temperature of the area are 20°C and 48°C (ADADP, 2001). The second field trial was conducted at School Farm of Government Girls' Secondary School, Kaltungo. Kaltungo is located in the South Guinea Savannah Ecological Zone of Nigeria within latitude 9° 48' N to 9° 51' N and longitude 11° 18' E to 11° 32' E with area of 881Km² (Wikipedia, 2011).

Source of Cotton Seeds Varieties

The cotton varieties used for this study were obtained from the Institute for Agricultural Research (IAR) Ahmadu Bello University (ABU) Samaru, Zaria. Their characteristics as described by descriptors IAR A.B.U. Zaria (2015) and cited by Idris, (2015) are as follows (Table 1).

Table 1: Description of Cotton Varieties Used

Variety	Maturity Period (days)	Characteristics	Yield kgh ⁻¹
SAMCOT 8 (SAMARU 77)	120-130	Medium staple variety belonging to <i>hirsutum</i> tall with open branches fruiting habit, hairy gland, leaves with 3-5 lobes. moderately resistance to bacterial blight and Alternaria leaf spot	1500-2000
SAMCOT 9	120	medium staple variety of <i>G. hirsutum</i>	2500-3000
SAMCOT 10	120	medium staple variety belonging to <i>G. hirsutum</i>	2500-3000
SAMCOT 11	-	long staple variety of cotton belonging to <i>barbadense</i> species that was released in 2003	long duration
SAMCOT 12	-	long staple variety belong to <i>barbadense</i> long Duration Species, released 2003	long duration

Source: IAR ABU, Zaria (2015)

Experimental Design and Field Layout

The experiment was laid out in a randomized complete block design (RCBD) replicated three times with varieties of cotton as the treatments. Each replication was separated by 2 metres apart and inter – plot spacing was 1.5m while the plot size was 3x4m² giving a plot size of 12m². The intra – plot spacing was 45cm and inter – plot spacing was 75cm

Cultural Practices

Seed treatment

Apron star 50Ds (metal-axyl 10%, Carboxin 6% + Furathiocarb 34%) at the rate of 10gm/3 kg of cotton seed was used to dress the seeds before planting in order to ensure good germination and protection against soil-borne and seed-borne pests and other predators such as ants and birds damage at germination and seedling stages (Malgwi, 2007).

Land preparation

The selected field was ploughed with a tractor when the rainfall was established in June, the essence of ploughing was to destroy the weeds and break the earth's crust for proper drainage. The land was leveled manually by using hand held hoe in order to pulverize and level the land to a fine tilt. The field was later designed according to the experimental design

chosen to create suitable beds for proper and adequate germination.

Sowing of cotton seeds

The seeds were sown on 24th June in location I (Yola) and 2nd July in location II (Kaltungo), 2022 cropping season, after the experimental fields were designed. The seeds were sown at rate of 4-6 seeds per hole, this was to ensure 100% establishment. The intra row spacing was 45cm, while inter row spacing was 75cm and sowing depth was 2.5-3cm and were later thinned to two plant per stand.

Weed control and fertilizer application

Weeding was carried out using hoe at two weeks after emergence and thinning to two plants per stand, and three weeks after the first weeding. Moulding-up was done three weeks after the second weeding. Weeding operation was carried out usually, two days after a heavy rainfall, this is to ensure ease operation and expose the weed to sunshine.

Fertilizer application

Nitrogenous fertilizer was applied at the early age of the plants. Single Super Phosphate (SSP) fertilizers were appropriately applied during the final land preparation and potash fertilizers at sowing time. A special fertilizer grade N. P. K 20-20-0 was applied at sowing time. After

seedlings have emerged, sulphate of ammonia was applied at the rate of 75kg ha^{-1} and was followed by another 75kg ha^{-1} at flowering time. This method of application has produced high yields in many areas.

Data Collection

Sampling D. volkeri F. during boll development

Sampling was carried out in the morning hours (0630 hours). The date of the sampling started at 12 week after sampling (WAS) and was done after every two weeks to 22WAS (boll opening). Species composition count of the *D. volkeri* F. was carried out using polythene bag. The *D. volkeri* was immobilized after they have been caught using ethyl alcohol on piece of cotton swab to prevent the insect from flying away and was collected in a bottle and was taken to laboratory for sorting, identification, counting and recording with the help of insect reference collection.

Data Analysis

The data collected in 2022 cropping seasons in both locations were subjected to analysis of variance (ANOVA) using (SAS, 2002) Software. Mean separation was done using Student Newman-Kuels (SNK) test of significance at ($p=0.05$).

RESULTS

Mean Weekly Population of *D. volkeri* in 2022 Cropping Season

The weekly mean population of *D. volkeri* in 2022 cropping seasons in the two locations (Yola and Kaltungo) was presented in Table 2 and 3. At Yola in 2022, it was on 18WAS that recorded the highest weekly mean population of *D. volkeri* (74.45), followed by 20WAS, with the population of (66.40) and 12WAS supported the lowest *D. volkeri* population

(26.85) on cotton (boll formation). At Kaltungo, *D. volkeri* population was found to be higher in 18WAS, (boll maturation) with a mean population of (58.60), followed by 20WAS with the mean population of (46.85). 12WAS and 14WAS supported the lowest insect pest population of 28.55 and 37.90 respectively. In a combined analysis 18WAS, the insect pest was higher with a population of (66.30) followed by 20WAS, with a mean population of (56.63), with the lowest mean population of (27.70) in 12WAS. The mean cumulative number of *D. volkeri* on five cotton varieties in 2022 cropping seasons in the two locations (Yola and Kaltungo) are presented in Table 3. There was highly significant difference in mean cumulative number of *D. volkeri* on five cotton varieties in 2022 cropping season. At Yola in 2022, the variety that had the highest population of *D. volkeri* was SAMCOT 10 with (49.46 per 10 plants of cotton) followed by SAMCOT 9 (48.83 per 10 plants), SAMCOT 12 (47.33 per 10 cotton plants) and the least population was on SAMCOT 11 (45.83 per 10 plants of cotton).

At Kaltungo, it was SAMCOT 10 that had the highest *D. volkeri* population (59.96 per 10 cotton plants) followed by SAMCOT 11 (45.46 per 10 cotton plants) and SAMCOT 8 (35.67 per 10 cotton plants) while the least population was on SAMCOT 12 (27.00 per 10 cotton plants). In the combined analysis, SAMCOT 10 was leading in the mean cumulative number of *D. volkeri* with (54.71 per 10 cotton plants) followed by SAMCOT 11 (45.65 per 10 cotton plants), SAMCOT 9 (44.65 per 10 cotton plants), SAMCOT 8 (42.81 per 10 cotton plants) and the least occurred in SAMCOT 12 with a population of insect pest (37.17 per 10 cotton plants) (Table 3).

Table 2: Mean Weekly Population of *D. volkeri* in 2022 Cropping Season in the Two Locations

Time (weeks)	Yola	Kaltungo	Combined analysis
12WAS	26.85 ^d	28.55 ^d	27.70 ^e
14WAS	32.70 ^d	37.90 ^c	35.31 ^d
16WAS	47.00 ^c	46.50 ^b	46.75 ^c
18WAS	74.45 ^a	58.60 ^a	66.30 ^a
20WAS	66.40 ^b	46.85 ^b	56.63 ^b
22WAS	42.30 ^c	31.85 ^c	37.08 ^d
Mean	48.28	41.71	44.99
CV (%)	15.69	18.69	17.18
SE _±	7.54	7.55	7.55
P>F	0.001	0.001	0.001

Means with the same letters in the same column are not significantly different at P = 0.05 using Student-Newman-Keuls (SNK). WAS = Weeks After Sowing; CV = Coefficient of Variation; SE = Standard Error.

Table 3: Cumulative Mean Number of *D. volkeri* on five Cotton Varieties in 2022 Cropping Season in the two Locations

Varieties	Yola	Kaltungo	Combined analysis
SAMCOT 8	49.96 ^a	35.67 ^d	42.81 ^b
SAMCOT 9	48.83 ^{ab}	40.46 ^c	44.65 ^b
SAMCOT 10	49.46 ^a	59.96 ^a	54.71 ^a
SAMCOT 11	45.83 ^b	45.46 ^b	45.65 ^b
SAMCOT 12	47.33 ^b	27.00 ^e	37.17 ^c
Mean	48.28	41.71	44.99
CV (%)	16.14	17.32	6.73
SE _±	7.79	7.22	7.51
P>F	<.001	<.001	<.001

Means with the same letters in the same column are not significantly different at P=0.05 using Student-Newman-Keuls (SNK). CV = Coefficient of Variation; SE = Standard Error.

Number of *D. volkeri* of 10 cotton plants at different growth stages of five cotton varieties in 2017 cropping season at Yola and Kaltungo were shown in Figure 1 – 3. At Yola in 2022, the highest peak population of *D. volkeri* occurred in SAMCOT 10 and SAMCOT 9 (99.00 and 81.20 per 10 plants of cotton respectively) while the least occurred on SAMCOT 12 with (14.80 per 10 plants of cotton). The growth stage of the cotton at which *D. volkeri* was most abundant was the boll maturation stage 18WAS (372.20) with the least occurring during boll formation Figure 1. At Kaltungo, the highest peak

population of *D. volkeri* occurred on SAMCOT 10 and SAMCOT 11 (79.00 and 66.80 per 10 plants of cotton respectively). The least occurred on SAMCOT 12 with (16.00 per 10 plants of cotton). The growth stage of the cotton at which *D. volkeri* was most abundant was the boll maturation stage at 18WAS (293.00) with the least occurring at the stage of ball formation Figure 2. In a combined analysis the population of *D. Volkeri* was most abundant at boll maturation stage (566.00) followed by bolls opening (468.80) with least population occurred during boll formation (314.85) (Figure 3).

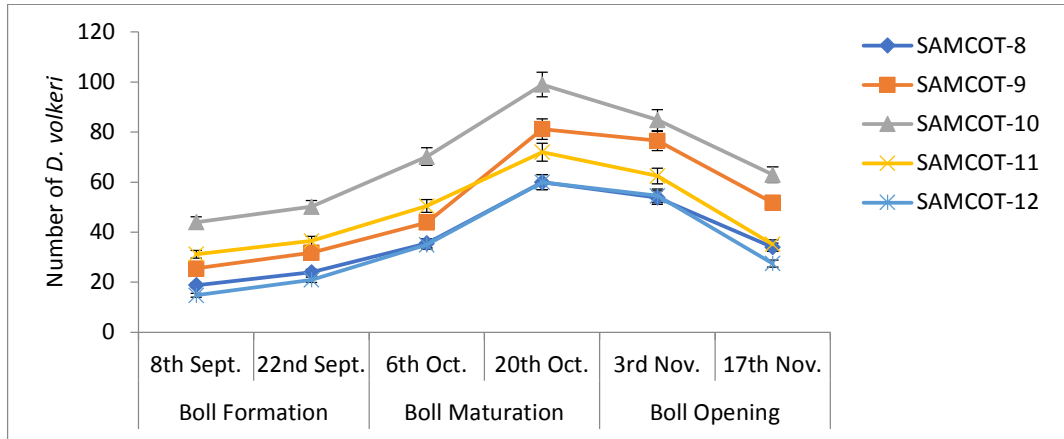


Figure 1: Number of *D. volkeri* per 10 plants of cotton at different growth stages on five cotton varieties at Yola in 2022 cropping season.

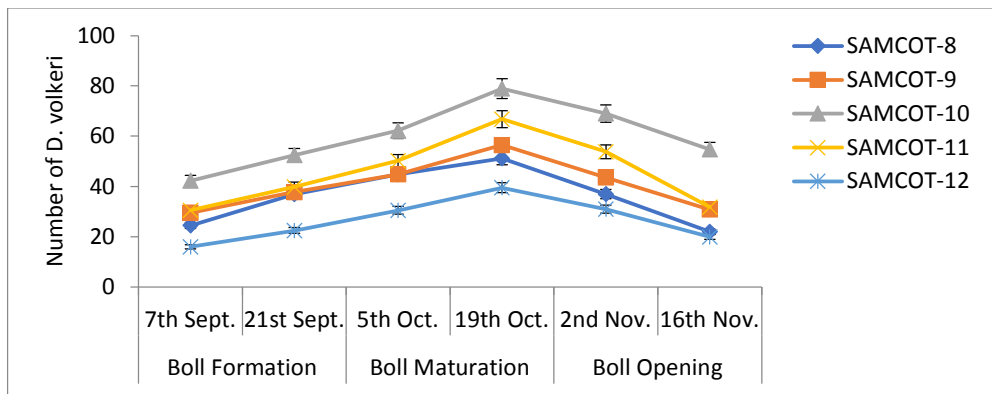


Figure 2: Number of *D. volkeri* per 10 plant of cotton at different growth stages on five cotton varieties at Kaltungo in 2022 cropping season.

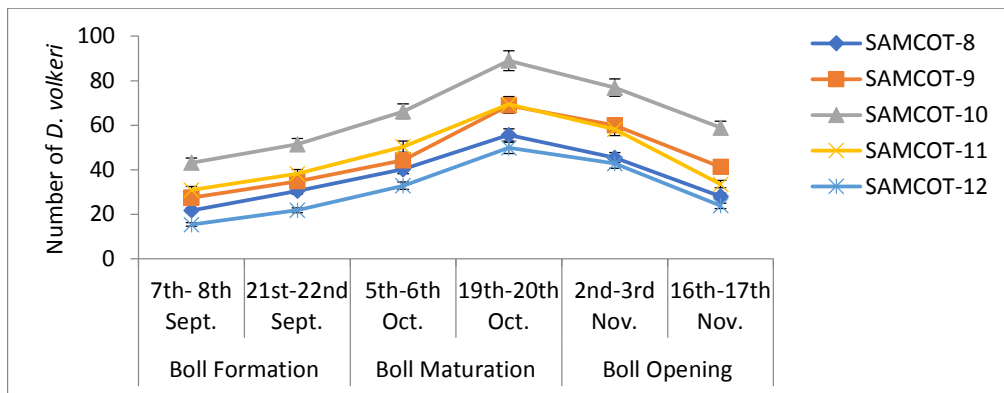


Figure 3: Number of *D. volkeri* per 10 plants of cotton at different growth stages on five cotton varieties in 2022 cropping season in combined analysis

DISCUSSIONS

From the results obtained in this study, there were two peak population periods of cotton stainer bug in a year. These were clearly shown in Yola and Kaltungo in 2022 cropping season. The seasonal fluctuation with respect to rainfall and temperature is an important factor in determining its abundance at a particular period of the year and at what stage of growth. The two peak periods from this studies work revealed that it was middle to third week of October 16 – 18 WAS and towards the end of October and first to second week of November 20WAS. At Yola and Kaltungo, the peak periods occurred in the same week in 2022 cropping seasons, but the population differs with highest population recorded in Yola and in Kaltungo the population is lower than that of Yola. This may be attributed to the fact that rainfall and temperature differed in the two locations and also the amount of land being put to the cultivation of the crop (cotton) this is in agreement with the findings of Willrich *et al.* (2014) that rainfall and temperature contributes to the distribution of insect pests.

However, Choice (2013) reported that peak population of *D. volkeri* occurred in late October, Turnipseed *et al.* (2003) reported that, the peak population of *D. volkeri* occurred in mid-October and late October. The difference of course could be due to the weather conditions of the two regions notably rainfall pattern which was observed by Willrich *et al.*, (2014) and therefore agrees with recent result in this research as shown on Figure 1-3. The peak period of infestation of cotton stainer bug also depends on the stage of crop development; usually it occurs at the matured boll development to the time of the opening boll so as to suck the sap of the lint and seeds. The mean weekly population of cotton stainer bug peaked at the second to third week of October at Yola and decline

thereafter on 18WAS and at Kaltungo the peak population was on 18WAS. The difference in varieties was significant in both locations. This result supported Jaleel *et al.*, (2013) that studied the population, biology and bionomics of *Dysdercus*.

The difference in the result of Yola and Kaltungo could be due to difference in weather condition especially rainfall. Based on the stage of cotton development, the highest population of cotton stainer bug was recorded at matured boll stage. This indicates that, the population of *D. volkeri* is higher during boll maturation. Therefore, abundance count should commence immediately at boll formation stage, because when you start at the flowering stage you may likely break the flowers since they are delicate and easily broken, and you may not have the cotton stainer bug at that time. Nevertheless, this research has provided some additional information needed which includes its abundance, the time of the year when they occurred and the growth stage of cotton preferred by the cotton stainer bug in Yola and Kaltungo in 2022 as reported previously by same reporters (Roberts *et al.*, 2005; Malgwi, 2007; Malgwi and Onu, 2011).

CONCLUSION

Result of population dynamics of cotton stainer bug *D. volkeri* on cotton showed that there were two peak periods of this insect pest in the two locations, it was middle to third week of October 16 – 18 WAS and towards the end of October and first to second week of November. However Yola recorded a high abundance more than Kaltungo. This may be attributed to the fact that rainfall and temperature differed in the two locations and also the amount of land being put to the cultivation of the crop (cotton). The mean weekly population of cotton stainer bug peaked at the second to

third week of October at Yola and decline thereafter on 18WAS and at Kaltungo the peak population was on 18WAS. The difference in varieties was significant in both locations. Therefore, the period of its abundance can be manipulated to avoid the attack of *D. volkeri* on cotton during the growing periods.

ACKNOWLEDGEMENTS

Sincere appreciation to Prof. (Mrs) A. M. Malgwi and Prof. M. M. Degri for their technical assistance in the conduct of this research. Also, special thanks to Dr. M. A. Medugu for his immense contributions from the start of this research up to its publication

REFERENCES

- Adeniji, O. B., Voh, J. P., Atala, T. K. and Ogungbile, A. O (2007).** Adoption of improved cotton production technologies in Katsina State Nigeria. *Journal of Applied sciences*, 7:397-401.
- Adamawa Agricultural Development Programme (ADADP), (2001).** Annual Report 2001, Adamawa state.
- Central Cotton Research Institute (CCRI), (2011).** Cotton stainer: an emerging serious threat for cotton crop production in Pakistan National base seminar in central cotton Research institute (CCRI) Multan, Panjah, Pakistan.
- Choice, M. A. (2013).** Pest and Diseases Control in Northern Nigeria. *Samaru Research Bulletin* 63:53-58
- Cotton Farming World Wide Fund (CFWWF), (2016)** <http://www.cottonfarming.org> Accessed, 16/01/2016.
- Idem, N. U. A., (1999).** Cotton Production in Nigeria. *Baraka Press and Publishers Ltd; Kaduna.* 33-45
- Idris, M. K. (2015).** Bt Cotton Will Boost Production in Nigeria image: <http://www.dailytrust.com.ng/image/like.png>. publish Date Jan 15,2015.
- Jaleel, W., Saeed, S. and Naqqush M. N. (2013).** Biology and bionomic of *Dysdercus Kaenigii* F. (Hemiptera: Pyrrhocoridae) under laboratory conditions *Pakistan Journal for Agricultural Science.* 50:379-378
- Malgwi, A. M. (2007).** *Bioecology, Damage Potentials and Control of Cylas Puncticollis* BOH, (Coleoptera: Brentidae) a New Pest of Cotton in Nigeria. Unpublished a Ph.D thesis Submitted to the Postgraduate School Ahmadu Bello University Zaria. 1-4pp
- Malgwi, A. M. and Onu, I. (2011).** The Effect of Sherpa plus on the abundance of *Cylas puncticollis* and some major insect pests on the yield of cotton at Ngurore, Nigeria, *Nigeria journal of tropical Agriculture (NJTA)* 2010, Vol. 12:28-41 ISSN 1595-5559.
- Ogunlela, V. B. (2004).** Improved Technologies for Increased Production in Nigeria. Proceedings of the Train the Trainers Workshop on Presidential Initiatives on Vegetable Oils, Cotton and Groundnut Production, *Lake Chad Research Institute* May 10-12 Maiduguri.
- Roberts, P., Bednarz, C., and Greene, J. (2005).** Impact of boll feeding bugs on lint yield and Fiber quality. In: Proc. 2005 Beltwide cotton conf. 4-7 Jan.2005. New Orleans, LA. National cotton council, Memphis, TN, Pp. 1718-1724
- Statistical Analysis System (SAS), (2002).** SAS/Stat. Users Guide, Version 6 4th Ed. 2.SAS Institute INC, Cary NC USA, pp 1675.
- Turnipseed, S. G., Sullivan, M. J., Hagerty, A. M. and Gibson, A. L. (2013).** Boll

damage by the stink bug/plant bug complex in South Carolina cotton. In: Proceeding of the Beltwide cotton conference, Nashville. TN. 6-10 January, 2003. National cotton council of America, Memphis.TN. Pp 1015.

United States Department of Agriculture Economic Research Service (USDAERS) (2013). March 5, 2013. 6-9

Wikipedia Kaltungo (2011). En. Accessed 2012/03/23. Available Wikipedia.org/wiki/kaltungo.

Willrich, M. M.; Leonard, B. R. and Temple, J. H. (2004). Injury to pre-flowering cotton, *Gossypium hirsutum* L. southern green stink bug, *Nezera viridula* (L). *Journal of Economic Entomology*. 97: 924-933.

Yafa, S. (2013). *Big cotton: The Biography of a Revolutionary Fiber Overview and Editorial review.*

