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EVALUATING THE EFFECTS OF VARIETIES ON SUCKING INSECT PEST AND DISEASES LIMITING SESAME PRODUCTION IN THE NIGERIAN GUINEA SAVANNA, PART B

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ABSTRACT: *The study on impacts of insects associated with five varieties of sesame, Sesamum indicum L. (pedaliaceae) was conducted at the Teaching and Research Farm, Federal University Wukari, in 2014 and 2015 cropping season. Insect species found on the crop at reproductive phase were sampled fortnightly. Phytophagous sesame pests identified were reported in part A of the study. This study evaluates diagnostic symptoms and severity of diseases vectored by these pests as viral leaf curls, cercospora leaf spots, galled capsule, bacterial blight and phyllody. The parameters measured were, Agronomic parameters and yield parameters. Results clearly shows, severity of these disease symptoms across the varieties, with E-8 variety being most tolerant (0.97±0.15) to leaf curl disease. Highest susceptibility was recorded in Yandev 55, for Cercospora leaf spots (1.93±0.06), galled capsule (5.79±0.64) and phyllody (1.96±0.23). NCRIBEN-01M gave the highest yield index, 6.09±0.36, and 5.99±0.12 for viable capsule counts. Average seed yield of 15.13±0.64kg/ha was recorded by the same variety in 2015 season, while ICEASE-00018 gave peak 1000 seed weights 1.69±0.07g and 1.88±0.13g in both seasons. The agronomic parameters show higher plant population (9.93±0.22 and 11.06±0.33) in ICEASE-00018 variety. Yandev 55 gave, 11.66±0.33cm and 11.40±0.23cm as peak plant height, while ICEASE-00018 gave 2.30±0.12 number of branches in 2014, but were not significantly different between varieties in 2015. NCRIBEN-O1M recorded peak stem girth, which however were not significantly different across the varieties. Yandev 55 had more leaves but was not significantly different across the varieties, and leaf area 8.04±0.47 and 8.46±0.52 was highest in same Yandev 55. The implications of these findings were further discussed.*

KEYWORDS: Sesame, Induced resistance, sucking pests, harvest index and diseases.

INTRODUCTION

Sesame *(Sesemum indicum L.)* known locally as beniseed belong to the family “Pedaliaceae”. It is the world’s most important oil crops produced in commercial quantity in Taraba State, Nigeria (Nigerias harvest, 2009). Increase in sesame production is a function of export, placing Nigeria as the 5th largest producer globally (Chemonics, 2002; FAO.2002) Bulk of the production is by small holders and much of the harvest is

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consumed locally, not only for culinary purpose, but also in traditional medicine for nutritive preventive and curative purpose. Sesame produce high quality edible oil, the seed contains 45-55% oil, 18-25% protein about 13.5% carbohydrates and ash about 5% (Borchamic *et al*, 2011; Hansen 2011). It is used for preparing salad and diverse soup condiments, in soap paints, medicine, perfumes and as a synergist for insecticides (RMRDC, 2004).

It is also a valuable ingredient in confection and baking industries (NAERLS, 2010)
Sesame yield in farmers field gave low harvest index probably constrained by low technology adoption, lack of improve seeds for planting and poor management options (Raikwar and Srivastra,2013). In addition to severe insect pest and pathogens (Ahmed, 2002; Chemonics, 2002, Hansen, 2010 and Mahmoud 2013) The crop is attacked by myriad of insect pests that constitute economic losses, particularly pest associated with the reproductive phase Uwala,(2002) and Egonyu *et. al.*, (2004) reported the impacts of these pests manifest in severe pathological effects through transmission of debilitating pathogens of fungal, viral and bacterial mycoplasma diseases (kumar, 1992; El-Gindy,2002; Talpur, *et al*, 2002; Fazal, *et al*., 2011; Mahmoud, 2012). Cellular collapse, galling and phyllody severity were also commonly associated with the crop (Akhtar, *et.al*.,2009). Yield losses up to 51.7% was reported in Nigeria due to Cercospora leaf disease (Enikuomehin, 2005), total (100%) yield losses are eminent.

When disease is the limiting factor for sesame production, evaluating reaction of the crops germplasm for resistant varieties will contribute immensely to integrated management along with advocacy for bio-pesticidal materials quest against vectors will advertently improve sesame yield (Biswass, *et. al.*, 2001; Wilson *et al.*, 2001; Toan *et. al.*, 2010; Fazal *et. al.*, 2011)

Inducible (varietal) defence are reported as a major factor in conferring resistance against phytophagous insects and pathogens (El-Gindy, 2002; El-Bramawy and Shaban, 2007). These defenses may increase plant fitness and are more durable defence mechanism showing positive effects on varieties of the crop through expression of dominant genes (Talpur, *et, al.*, 2002; Sintim *et.al.*,2010; Fazal *et. al.*, 2011 and Mahmoud *et. al.*, 2013).
The break down in resistance coupled with development of virulent strains (pathogens) now has negative consequences in sesame production (El-Gindy, 2002; Egonyu *et. al.*, 2005; El-Bramawy and Shaban 2007). This study is a continuation of part A, aimed to investigate the effects of varietal tolerance to pathogenic infections transmitted by sesame sucking pests and their impacts on sesame harvest index.

MATERIALS AND METHOD

This study was carried out to investigate the performance of different sesame varieties in relation to the impacts of major pest insects associated with the crop and the pathological effects of diseases transmitted by these pests in 2014 and 2015 cropping season. All experiments were laid out in the Teaching and Research farm of the Federal University Wukari, Lat.07^{0}50'- 07^{0}82'N, Long. 09^{0}68'- 09^{0}89'E. The soil texture at the study site

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was sandy soil (76.80% sand, 15.20% clay and 8.0% silt), Relative humidity,77% and mean annual rain fall of 800-1400mm, with a peak environmental temperature 27- 29^{0}C, and pH, 5.75.
Five sesame varieties, Yandev 55; NCRIBEN-01M; E-8; Ex-Sudan, and ICEASE-00018, were drilled 40cm x 10cm inter row and intra row spacing, each experimental units measuring an area of 3.5 x 4m^2 plot at the recommended seed rate of 40kg/ha. Planting data was 24th June 2014 cropping season and repeated in 2015 season, in this experiment, each variety had five rows with four replications laid out in randomized complete block design (RCBD)

All agronomic practices were strictly observed. First dose of fertilizer was applied 4WAP and second dose 6WAP, while weeding was done manually. Management spray of cypermethrin was done at 4WAP. Flowering commenced at 6.5WAP for Yandev 55, E-8 and Ex-Sudan, while 8.5WAP for NCRIBEN-01M and 6.0WAP for ICEASE-00018, throughout the season.

Observation for disease symptoms and counts involved five plants per plot tagged as sub plots and all data taken from these plants. Twenty five sesame leaves per variety were examined at weekly interval from each plot, leaves were carefully examine using x 10 hand lens for diagnostic symptoms and other abnormalities in growth of the plants. Data taken includes, number of viable capsules and deformed capsules per plant; number of curl leaves per plant, incidence of leaf spots scored on 1-5 scales; number of dead branches per plant and leaf area; seed yield per plot and 1000 seed weight per variety, using Mettler digital sensitive balance, was obtained. All data's collected were squired root transformed and subjected to ANOVA, using the statistical package SPSS, version 21. Treatment means that are significant were separated using the new Duncan Multiple Range Test (Ducan^2) at $\alpha = 0.05$ level of significance (Gomez and Gomez, 1984)

RESULTS

The disease index (symptoms) observed per variety recorded in Table 3.0 showed severity of leaf curls was lowest in E-8 variety as 0.97±0.15, followed by Yandev 55, with 1.29± 0.33 in 2014, while same E-8 variety has 1.18±0.18 and Yandev 55 gave 1.27±0.21 in 2015 season, indicative of being more tolerant variety. NCRIBEN-01M, recorded 1.87±0.00 and 1.86±0.11 in 2014 and 2015 season, followed by ICEASE-00018 with 1.97±0.22 and 1.83±0.21, with index of higher susceptibility.

There was statistically significant difference between the varieties as relates to severity of leaf curls. Severity of fungal leaf spots presented similar pattern as above with Yandev 55 being relatively susceptible with 1.93±0.06 and 1.92±0.16 scores in 2014 and 2015 cropping seasons. While NCRIBEN-01M showed appreciable resistance with the fungal spot scores of 1.31±0.09 and 1.40±0.10 for the two cropping season respectively. All through the sesame varieties, severity of fungal leaf spots were significantly different but was more severe in the 2014 cropping season.

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The number of galled capsules was highest in Yandev 55(5.93±0.06) and Ex-Sudan (5.91±0.53) in the two cropping seasons respectively, while the lowest was in ICEASE-00018 variety with 4.63±0.61 and 4.67±0.39, for the 2014 and 2015 cropping seasons. Across the varieties in both seasons, the numbers of galled capsules were not significantly different.

Some numbers of dead stands resulting from phyllody were evidently recorded in Yandev 55 (1.96±0.23) and Ex-Sudan (2.65±0.27) in the 2014 and 2015 cropping season respectively. While E-8 (1.59±0.34) and NCRIBEN-01M (1.72±0.32) were lowest in both cropping seasons. Across the varieties Phyllody effects were significantly different, but much effects were recorded in the 2015 cropping season.Yield component of these sesame varieties gave the viable capsules recorded 10WAP as 6.09±0.36 and 5.99±0.12 for NCRIBEN-01M being the highest number. While E-8 variety with 4.33±0.54 and 3.93±0.45 in the two cropping season recorded the lowest number of viable capsules. These were however significantly different across the varieties.

Seed yield in kilograms per hectare gave ICEASE-00018 (12.78±0.48kg) followed by NCRIBEN-01M (12.30±2.69kg) in 2014 cropping season. While in 2015 NCRIBEN-01M with 15.13±0.64kg and ICEASE-00018 (14.26±0.43kg) recorded the highest seed yields. Least performed varieties were E-8 (6.00± 1.04kg) in 2014 and 7.77±0.65 in 2015. Across the varieties, seed yields were significantly different.

One thousand seed weight in grams of the sesame seeds gave 1.75±0.05g in Yandev 55 and 1.69±0.07g in ICEASE-00018 in 2014 season. While 1.88±0.13g and 1.84±0.04g were recorded for ICEASE-00018 and Yandev 55 respectively in 2015 cropping season. These figures were statistically significant across the varieties in both cropping season.Agronomic parameters of the sesame varieties in Table 2.0 show peak plant population that survive in each variety as 11.06±0.33 and 10.33±0.25 in ICEASE-00018 and Ex-Sudan respectively in 2015 cropping season. While the lowest plant population was 7.60±0.49, in E-8 in 2014. In all there were statistically significant differences between the varieties and the two cropping seasons. Plant height at 12WAP was 11.66±0.33cm in Yandev 55 in 2014 cropping season, while 10.46±0.08cm in E-8 for 2015 cropping season, There was statistically significant difference between the varieties in 2014 and not in 2015.

The number of branches at 12 WAP was 2.32±0.16 in Ex-Sudan, 2.30±0.12 in ICEASE-00018 in 2014. NCRIBEN-01M and Ex-Sudan gave 2.36±0.11 and 2.34±0.17 number of branches in 2015 cropping season. Generally there was no significant difference in the number of branches between the varieties in 2015, except for 2014 cropping season.
Stem girth at 12WAP was 1.90±0.06cm and 1.94±0.13cm in NCRIBEN-01M for 2014 and 2015 cropping seasons. Yandev 55 had 1.59±0.30cm in 2014, and ICEASE-00018 had 1.70±0.08cm in 2015 being the lowest girth. However, both were not significantly different between the cropping seasons.

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Average number of leaves was uniform amongst the varieties in both cropping season, but Yandev 55 had 4.47±0.27 leaves and 4.83±0.31 leaves in 2014 and 2015 as the highest. While, 3.78±0.25 and 4.12±0.20 leaves were recorded in Ex-Sudan, however, there numbers were not significantly different between the varieties in both cropping season.

The leaf area recorded were 0.04±0.47cm^2 and 8.46±0.52cm^2 for 2014 and 2015 in Yandev 55. While ICEASE-00018 gave 6.33±0.18cm^2 and 6.17±0.31cm^2 in both cropping season. However, these values show statistically significant differences in both cropping seasons.

DISCUSSION

Severe disease symptoms were evidenced across the varieties, throughout the cropping seasons but individual varieties show different responses, which could be attributed to varied levels of tolerance, since yield was significant despite the non application of protective pesticides. E-8 variety was more tolerant variety to leaf curls, presumably transmitted by whiteflies and thrips, while NCRIBEN-01M and ICEASE-00018 were most moderately, susceptible to the same viral infection. Effects of leaf curls on the varieties were however, significant.

Cercospora leaf spots caused by *fungi imperfecti* (Nahunnaro *et. al.*, 2013) was similar in trend with relative susceptibility exhibited by Yandev 55, while appreciable tolerance (relative resistance) was seen in NCRIBEN-01M in both cropping season, with 2014 being most affected by the fungal leaf severity, most probably due to high humidity (Ahmed *et.al.*, 2014 Enikuomehin, 2005).

Galling of capsule due to *Asphondyla Sesame* feeding was pronounced in Yandev 55 and Ex-Sudan, hence the significant draw down on the seed yield out put. ICEASE-00018 variety however, showed lower effect of the pests feeding, despite the Population build up throughout the study period particularly in 2015. Appreciable number of sesame plants died showing clear symptom of phyllody a bacterial infection caused by phytoplasmas (Esmailzadeh, *et. al.*, 2007, Fazal *et. al.*, 2011) exhibiting high prevalence of recent in Nigeria. Whiteflies, Thrips and Aphids are most incriminated insects in its transmission, symptomed by shoot apex fasciation, cessation of internode elongation and virescence (Wilson *et. al.*, 2001).

Yandev 55 and Ex-sudan have shown evidence of higher susceptibility due to severity of dead sesame stands, with E-8 and NCRIBEN-01M showing some (moderate) level of tolerance, as evidenced in their yield compared to Yandev, 55 and Ex-Sudan, nevertheless, across the varieties, effects of phyllody was significant and most severe in 2015 cropping season.

Yield performance index despite the multiple infections was better in NCRIBEN-01M, while E-8 recorded the lowest yield index of viable capsules, but shows significant difference with other varieties. Seed yield in kilograms per hectare was best in ICEASE-

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00018, followed by NCRIBEN-01M, while E-8 and Yandev 55 yield were lower probably because of their higher susceptibility and higher effects of these disease agents. Vigorous yields were attainable with right plant population per hectare and attendant weather effects. Despite the multiple incidences of pathogenic effects in the Yandev 55 variety, seed weight was appreciable along with the relatively tolerant ICEASE-00018. This could be attributed to some level of compensation or escape exhibited by the capsules and the seed components by possession of anti nutrient profile acting as feeding deterrent and chemically toxic to the pathogens (Mahmoud,2013).

Agronomic parameters exhibited higher plant population in ICEASE-00018 and Ex-Sudan in both seasons, despite the intensity of infection sustained, several of the plants survived and appreciable number of capsules are viable. At 12WAP Yandev 55 and NCRIBEN-01M were tallest but show lower index of lodging, since both varieties have appreciable girth sizes, that were not significantly different across the varieties.

ICEASE-00018 variety and Yandev 55, gave higher number of branches, hence more likely yield as reported above, in the 2015 season no significant difference was recorded and number of branches were uniform across the varieties. More number of leaves is an index of increased photosynthetic activities as exhibited by Yandev 55 and NCRIBEN-01M in both cropping season, Corroborating the findings of Iwo,*et.al*.(,2002) on higher vegetative number and increased leaf area shown by Yandev 55 and E8 as probable indicators to improve yield performance of a crop variety (Langham, 2007; Haruna *et. al.*, 2012)

CONCLUSION AND RECOMMENDATION

From the study, it could be concluded that the different varieties of sesame show symptoms of the various pathogens at various stages of growth. Despite the high disease conditions, the sesame variety ICEASE-00018 was more tolerant, while E-8 and Yandev 55 were significantly susceptible. There is need to further ascertain levels of tolerance to these insect vectors and pathogens effect on sesame in the study area. This study may serve as bench mark for further studies in breeding resistant cultivars.

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APENDIX

RESULTS

Table 1.0 Taxonomic Status of Pathogens Infecting sesame encountered in the study area throughout the cropping seasons.

s/n	Species	Causative Agents	Status	Area of Attack
1	*Cercospora Sesami* fungal leaf spot	*Fungi Imperfecta*	Major	Severe leaf Spot
2	Viral leaf curls	Tobacco Curl Virus	Major	Leaves
3	Bacterial Blight	*Xanthomonas* spp *compestris* pv *sesame*	Minor	Leaves and branches prevent seeding germination and growth
4	Phyllody	Phytoplasma (Bacterial)	Major	Stem apex & floral parts & nodes
5	Sesame galls	*Asphondylia Sesami* Felt	Minor	Floral & capsules

Source, 2014/2015 survey

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Table 2.0 Agronomic Parameters of Sesame Varieties Observed in 8-12 Weeks After Planting and Without Protection, Throughout The Cropping Seasons.

Varieties	Plant Popn.	Plant Height (cm)12WAP	No of branches at 12WAP	Stem girth (cm) at 12WAP	Mean no of leaves at 12WAP	Leaf Area (cm) at 8WAP
2014						
Yandev 55	7.98±0.34^{bc}	11.66±0.33^{a}	2.12±0.04^{ab}	1.59±0.30^{a}	4.47±0.27^{a}	8.04±0.47^{a}
NCRIBEN-01M	8.50±0.59^{abc}	11.18±0.18^{ab}	2.08±0.15^{ab}	1.90±0.06^{a}	4.43±0.11^{a}	7.11±0.17b^{c}
E8	7.60±0.49^{c}	10.59±0.23^{b}	1.87±0.13^{b}	1.73±0.07^{a}	4.22±0.23^{a}	7.71±0.25^{ab}
Ex-sudan	9.50±0.71^{ab}	10.66±0.17^{b}	2.32±0.16^{a}	1.80±0.10^{a}	3.78±0.27^{a}	7.04±0.19^{bc}
ICEASE-00018	9.93±0.22^{a}	10.53±0.55a	2.30±0.12^{a}	1.87±0.05^{a}	4.10±0.28^{a}	6.33±0.18^{c}
2015						
Yandev 55	9.42±0.65^{b}	11.40±0.23^{a}	2.18±0.12^{a}	1.96±0.11^{a}	4.83±0.31^{a}	8.46±0.52^{a}
NCRIBEN-01M	10.20±0.16^{ab}	11.17±0.33^{a}	2.36±0.11^{a}	1.94±0.13^{a}	4.75±0.22^{a}	7.64±0.41^{ab}
E8	7.94±0.76^{c}	10.46±0.08^{a}	2.00±0.11^{a}	1.93±0.04^{a}	4.50±0.18^{a}	8.42±0.28^{a}
Ex-Sudan	10.33±0.25^{ab}	10.60±0.27^{a}	2.34±0.17^{a}	1.92±0.05^{a}	4.12±0.20^{a}	6.94±0.35^{bc}
ICEASE-00018	11.06±0.33^{a}	10.65±0.55^{a}	2.33±0.14^{a}	1.70±0.08^{a}	4.37±0.25^{a}	6.17±0.31^{c}

Means followed by same letters within a column are not statistically different at 5% level of significance, according to DMRT (Duncan[2])

Table 3.0 Disease Index Observed in Sesame Varieties Without Protection, Throughout the cropping Season.

Varieties	**Severity of Leaf Curls**	**Severity of Fungal Leaf Spot**	**Number of galled capsules**	**Number of dead stands due to phyllody**
2014				
Yandev 55	1.29±0.33^{ab}	1.93±0.06^{a}	5.79±0.64^{a}	1.96±0.23^{ab}
NCRIBEN-01M	1.87±0.00^{a}	1.31±0.09^{c}	5.70±0.38^{a}	1.83±0.37^{ab}
E-8	0.97±0.15^{b}	1.86±0.11^{ab}	5.73±0.51^{a}	1.65±0.07^{b}
Ex-Sudan	1.85±0.18^{a}	1.80±0.07^{ab}	5.46±0.32^{a}	1.59±0.34^{a}
ICEASE-00018	1.97±0.22^{a}	1.65±0.07^{b}	4.63±0.61^{a}	1.81±0.28^{ab}
2015				
Yandev 55	1.27±0.21^{bc}	1.92±0.16^{a}	5.14±0.99^{a}	1.92±0.13^{ab}
NCRIBEN-01M	1.86±0.11^{a}	1.40±0.10^{b}	5.41±0.41^{a}	1.72±0.32^{b}
E-8	1.18±0.18^{c}	1.63±0.19^{ab}	5.40±0.79^{a}	1.86±0.11^{ab}
Ex-Sudan	1.79±0.13^{ab}	1.72±0.14^{ab}	5.91±0.53^{a}	2.65±0.27^{a}
ICEASE-00018	1.83±0.21^{a}	1.57±0.13^{ab}	4.67±0.39^{a}	2.10±0.35^{ab}

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Means followed by same letters within a column are not statistically different at 5% level of Significance according to DMRT (Duncan[2])Table 4.0 Yield Components of Sesame Varieties Recorded without Protection in the two Cropping Seasons.

Varieties	Viable Capsules per plant 10WAP	Average Yield of Sesame Seed (kg/hat)	1000 Seed Weight (g) of Sesame
2014			
Yandev 55	5.55 ± 0.33^{ab}	6.30 ± 1.54^{b}	1.75 ± 0.05^{a}
NCRIBEN-10M	6.09 ± 0.36^{a}	12.30 ± 2.69^{a}	1.57 ± 0.05^{ab}
E-8	4.33 ± 0.54^{b}	6.00 ± 1.04^{b}	1.49 ± 0.11^{b}
Ex-Sudan	4.40 ± 0.47^{b}	8.36 ± 0.57^{ab}	1.64 ± 0.07^{ab}
ICEASE-00018	4.47 ± 0.19^{b}	12.78 ± 0.48^{a}	1.69 ± 0.07^{ab}
2015			
Yandev 55	5.06 ± 0.28^{ab}	8.86 ± 1.05^{b}	1.84 ± 0.049^{a}
NCRIBEN-10M	5.99 ± 0.12^{a}	15.13 ± 0.64^{a}	1.75 ± 0.05^{ab}
E-8	3.93 ± 0.45^{b}	7.77 ± 0.65^{c}	1.60 ± 0.03^{b}
Ex-Sudan	3.97 ± 0.44^{b}	11.18 ± 0.94^{b}	1.74 ± 0.05^{ab}
ICEAS-00018	5.00 ± 0.42^{ab}	14.26 ± 0.43^{a}	1.88 ± 0.13^{a}

Means followed by same letters within a column are not statistically different at 5% level of significance, according to DMRT (Duncan[2])

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