Global Journal of Agricultural Research

Vol.5, No.1, pp.9-19, April 2017

Published by European Centre for Research Training and Development UK (www.eajournals.org)

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

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ABSTRACT: *Sesame yields from farmers fields are of great concern. Among the various factors that constrain production are biotic pressures associated with the reproductive phase. Sesame exhibit high genetic variability, believed to contribute to increase plants fitness and expression of tolerance (varietal) levels. Advocacy for bio-pesticides had opened a new horizon in safety precaution, eco-friendliness and more rational pest management continuum. In this study, performance of five sesame varieties and bio-pesticides effects on these pests were evaluated in 2014 and 2015 cropping seasons, all treatments were applied as foliar sprays fortnightly. Observation for pest population count commenced at flower buds, through capsule formation to physiological maturity. Five plants per plot (subplots) were tagged, all data taken were square root transformed before analysis, and low pests population sampled across the varieties in 2014 were significantly different except for 2015. Sesame yield significantly appreciated with the pesticides protections, Cypercal® gave 9.11± 0.47kg/ha and 14.54± 1.26kg/ha for both seasons. Except for NCRIBEN-01M in 2014, all effects in 2015 and E-8 in 2014/2015 yields effects were not significantly different, both treatments across the varieties gave yield advantage over the control. Seed weight gains was recorded across the varieties compared to the control, these gains were statistically significant, except for Ex-sudan and ICEASE-00018. Agronomic parameters of these sesame varieties were uniform across both treatments and seasons, showing significant contribution to the yield proficiency, but were not statistically different. Both bio pesticides gave varied levels of protection to sesame against these sucking pests. The sesame varieties contributed some levels of protection, through their varietal responses, evidenced in low pests' population per variety and yield advantage over the control, while the agronomic parameters accounted for yield increases.*

KEYWORDS: Sesame, Sucking pests, bio-pesticides, harvest index and diseases

INTRODUCTION

Sesame, *Sesamum indicum* L., known locally as beniseed belong to the family "Pedaliaceae" is one of the world's most important oil crops produced in commercial quantity in Taraba state, particularly Bali and Donga Local Government Areas. Being a non-irrigated crop, yet two plantings are achieved within a cropping season, i.e. early planting (April-July) and late planting (August – November). It is cultivated as sole crop or intercropped with other grains and has a relatively short harvest cycle of 90-140DAP, which allow other crops to be grown in the same field after harvest (USAID, 2002; Nahunnaro *et al*, 2013).

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

In Nigeria, Sesame is considered as food crop rather than oil seed crops, because most traditional delicacies utilize the seed directly (NAERLS, 2010). Beniseed oil is of high quality natural anti-oxidant preventing aging and regeneration of liver cells (rejuvenation), rich in protein profile and as synergist for insecticides, Pharmaceutics, paints, canned foods and ethno botanical uses (FAO 2002; RMRDC,2004).

Increase in sesame production is a function of export or international markets demand from Japan, valued at about USD 20 million (USAID 2002). NAERLS (2010) gave global production in 2005 as 3.15million metric tonnes, with China and India as leading producer. Nigeria is 5th largest producer in the world, with an estimated output of 139,000 metric tons annually (Chemonics, 2002; UN/FAO, 2008; CBN, 2009; Nigerian Harvest, 2009).

Sesame produces high quality edible oil with nutritional composition for other utilizations in livestock feeds and many valued products (Weiss and Dela-cruz, 2001; Iwo *et al*, 2002; USAID, 2006; NAERLS, 2010, GluCroft, *et al*., 2012). The crop is considered an orphan crop in Nigeria but with recent interest and global market demand, the Nigerian national government had committed several funds in research, production and marketing. Nevertheless, low harvest index (LHI) is still prevalent far below the experimental yield potentials of the crop (Chemonics, 2002; NCRI, 2002).

The seed yields on farmers fields range between 90-300kg/ha (Alegbejo *et al*., 2003) while experimental stations in Samaru recorded 299kg/ha – 930kg/ha for Yandev 55 and between 536kg/ha and 1080kg/ha for E-8 varieties (Ingawa *et al*., 1986; Misari and Iwo, 2002, NCRI, 2002; NAERLS, 2010). Amongst the various factors that constrains production of sesame and accounts for the low harvest index are the insect pests associated with the reproductive phase (Uwala, 2002; Biswass, *et al*., 2004; Ahmed *et al*., 2014). These causes physical damages less than those of foliage pests, yet their impact on final yield is huge. These sucking insects inflict great economic losses to sesame production. They cause severe damage directly by sucking plant saps or indirectly by transmission of virus and mycoplasma diseases (El-Gindy, 2002; Talpur *et al*., 2002). Of note are the incidence of whiteflies, *Bemisia tabaci* (Gennadius) which transmits the leaf curl virus disease, Thrips, *Thrips tabaci* Lind, and the green peace Aphids *Myzus persicae* (Sulzer) that causes extensive capsule deformities and transmits various mycoplasmas and other bacteria diseases of Sesame (Mahmoud, 2012). The gall midges *Asphondylia Sesame* Felt, additively causes extensive galling of the capsule (Sintim, *et al*., 2010).

Furthermore, these pests cause extensive cellular collapse during feeding, leading to stunted and subnormal growth of the tissues and capsules. Also *Asphondylia* and whiteflies have been incriminated in phyllody, leaf curls and gall disease transmission in sesame. El-Gindy (2002, 2006) and El-Bramawy and Shaban (2007) reported inducible defense (varietal), as a major factor in conferring resistance against phytophagous insects and pathogens, through increase toxicity, delayed larval development or increased attack by insects predators and parasitoids. These defences may increase plants fitness and are more durable defence mechanisms showing positive effects on varieties of the crops, through expression of dominant genes. However, advocacy for botanical pesticides had been protective (Ahmed, 2002; Ahirwal *et al* 2010; Sharma *et al*, 2012; Isman, 2013; Ahmed *et al*, 2014).

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

Nevertheless, Mahmoud (2012), Ndakidemi *et al.* (2016) advocated caution to safe guard the beneficial insects and the environment.
This study aims to evaluate the effects of varieties and bio-pesticides on insects limiting sesame production as it relates to small holder production.

MATERIALS AND METHODS

This study was carried out to evaluate the performance of different sesame varieties in relation to the impacts of major pest insects associated with sesame and bio-pesticides impacts 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 and Lat. 09^{0}68' 09^{0}89'E. The soil texture at the study site was sandy soil (76.80% sand, 15.20% clay and 8.0% silt), RH, 77% and mean annual rainfall of 800 - 1400mm with a peak environmental temperature, 27^0 - 29^{0}c and $_P$H,5.75.

Five sesame varieties: Yandev 55; NCRIBEN-01M; E-8; Ex-Sudan and ICEASE-00018, were obtained from NCRI Badeggi and BSADP, Yandev Gboko. The planting materials were seed dressed with Apron star (3g/kg) seed to prevent fungal and bacterial rot and were drilled 40cm x 10cm inter row and intra row spacing. Each experimental unit measuring an area of 3.5 x 4m^2 plots, with the recommended seed rate of 4.0kg/ha, planting date was 24th June 2014 cropping season and repeated in 2015. Germination was on 3rd July, thinning at 3WAP to 2 plants per hill.

The bio-pesticidal materials were, Neemix® *(Azadirachta indica)* and Cypercal® (Cypermethrin) obtained from a chemical shop and applied at the recommended 2ml/l. Cypercal® is used as a standard check. While Jatropha seeds (*Jatropha curcas* Linn) and Ocimum (*O. Basilicum)* were collected from the wild and manually processed into aqueous seed extracts and applied at 5ml/L application rates. These pesticides treatments were at two weeks interval spray regime, after every insect counts within a treatment plots, commencing at flower bud stage (36WAP).

All agronomic practices were strictly observed, first dose of fertilizer was applied on the 4th WAP and second dose at 6WAP, while weeding was done manually (Haruna *et al*., 2012). Flowering commenced at 6.5WAP for Yandev 55, E-8 and Ex-Sudan, while 8.5WAP for NCRIBEN-01M and 6WAP for ICEASE-00018 in both seasons.

Observation for pest population count commenced at flowering through capsule formation, physiological maturity and harvest. Five plants per plot were tagged as subplots and data taken from the top, middle and bottom of these plants. Twenty five sesame leaves were sampled at weekly interval from each plots early in the morning (7-10am), leaves were carefully examined using X10 hand lens to count individual insects per leaf. The population of insect's infestation were calculated and recorded. Seed yield per plot and 1000 seed weights per variety, were obtained using Mettler digital sensitive balance. All data collected were square 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 (Duncan^2) Test at $\alpha = 0.05$ level of significance (Gomez and Gomez, 1984).

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

RESULTS

Taxonomic status of economic insect pest associated with sesame encountered in the study area is shown in table 1.0. The mean population of sesame sucking pests recorded on each variety in relation to bio-pesticides treatment is shown in table 2.0. Yandev 55 in 2014 and 2015 trials gave control treatment (4.34 ± 0.48, and 5.34±0.82) to be significantly different from other treatments. The least population was recorded in Cypercal® treated plots (2.20±0.33), followed by Ocimum (2.73± 0.33) and Neemix® (2.85±0.23). Same trend was observed in 2015 with least infestations in Cypercal® treatments (2.47±0.77) followed by Neemix ® (2.54±0.43).
In 2014, the variety NCRIEN-01M showed statistically significant difference (P>0.05) between the control and the treated plots but lowest population (1.98+0.17) recorded was from cypercal ® treated fields followed by Jatropha oils (2.55±0.28). The above however was not the trend in 2015, where all treatments were not significantly different statistically. Yet Cypercal ® maintained lowest population of the insect pests (2.33±0.44).

The variety E-8 also showed the trend of non statistical difference in both years and the different pesticidal material. In 2014, Ex-Sudan variety gave statistically significant difference between the bio-pesticides treatments and the control (3.72±0.90), but was not statistically significant between bio-pesticides. In 2015, there was no noticeable difference between all treatments. Icease-00018, maintained the above trend in both 2014 and 2015, yet Cypercal® treatment gave the least pest populations (2.18±0.29) recorded.

Sesame yield significantly appreciated with the pesticides protections, with the peak in Cypercal ® of 9.11±0.47 and 14.54±1.26, in 2014 and 2015 respectively followed by Neemix ® 9.50±0.50 and 9.74±0.85 in 2014 and 2015 respectively; Jatropha seed oil, 9.61+0.71 and 9.43±0.65 in both cropping seasons for Yandev 55. The same trend was observed in NCRIBEN-01M and E-8.

Except for pesticides effects on NCRIBEN-01M in 2014, all effect on NCRIBEN-01M in 2015, E-8, 2014 and 2015, were not significantly different. Jatropha seed oil out performed Neemix ® in E-8. In ICEASE-00018, Jatropha oil gave the peak yield of 9.05±0.93 and 15.50±1.33 in 2014 and 2015 respectively but are significantly different compared to other treatments. Ex-Sudan however showed some yield advantage compared to the control (7.20±0.49) but are statistically non significant although peak yield was 13.9±0.80 in Cypercal® treated fields, yet there were significant differences between the various treatments.

The pesticidal materials and the varieties Yandev 55 and NCRIBEN-01M, seed weights were 1.63±0.12 and 1.61+0.11 for Jatropha oil and Cypercal ® treatments as against 1.29±0.10 in the control treatment. This show some appreciable seed weight gains, however, there was no statistically significant difference between the treatments on the two varieties Yandev 55 and NCRIBEN-01M, for both cropping seasons of 2014 and 2015.

In 2014 cropping season, E-8 seed weight was 1.20±0.03, while 1.17±0.04 for 2015 in the control treatments. Appreciable seed weight gains recorded 1.64±0.02 and 1.54±0.09 in Cypercal® treated plots for 2014 and 2015 cropping seasons respectively. However, the effects were statistically significant in both years. The trend was also observed in Ex-sudan and ICEASE-00018 with 1.47±0.14 and 1.22+0.09 for the control in Ex-sudan respectively in 2014 and 2015. While Cypercal® gave 1.65±0.06 and 1.40±0.07 seed weight increases in both years.

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

ICEASE-00018 had 1.25±0.02 and 1.30±0.09 for control in both years, while 1.61±0.05 and 1.60±0.12 were recorded seed weight increases for 2014 and 2015 cropping seasons respectively. Nevertheless in 2015, both Ex-sudan and ICEASE-00018 effects of the treatments on seed weight gains were not statistically significant.

Agronomic parameters of the sesame varieties is shown in Table 6.0, peak plant population that survive in each variety was 11.06±0.33 and 10.33±0.25 in ICEASE -00018 and Ex-sudan respectively in 2015 cropping season. While the least 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 highest in Yandev 55 (11.66±0.33cm) in 2014 cropping season, while the lowest was 10.46±0.08cm in E-8 in 2015 cropping season. There was statistically significant difference between the varieties in 2014, while in 2015 the plant heights were not significantly different.

The number of branches at 12WAP was 2.32+0.16 in Ex-sudan, followed by 2.30±0.12 in ICEASE-00018 in 2014, while NCRIBEN-01M and Ex-sudan gave 2.36±0.11 and 2.34±0.17 number of branches respectively, 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 highest in NCRIBEN-01M, 1.90±0.06cm and 1.94±0.13cm in 2014 and 2015 cropping seasons. Yandev 55 had 1.59±0.30cm in 2014 and ICEASE- 00018 had 1.70±0.08cm in 2015 as the lowest stem girth, both however, were not significantly different between the cropping seasons of 2014 and 2015.

Average number of leaves was uniform across the varieties in both cropping season, but Yandev 55 had the highest number of leaves of 4.47±0.27 and 4.83±0.31 in 2014 and 2015 cropping season respectively. While the least was 3.78±0.25 and 4.12 ± 0.20 in Ex-sudan, however these numbers were not significantly different between the varieties in both cropping seasons.

The leaf area was highest in Yandev 55, with 8.04±0.47cm^2 and 8.46±0.52cm^2 for 2014 and 2015, while ICEASE-00018 had 6.33±0.18cm^2 and 6.17±0.31cm^2 in both cropping seasons; however, across the varieties the leaf areas are significantly different in both cropping season.

DISCUSSION

Different insect pests attack sesame crop at its various stages, taxonomic status of economic pests recorded in the study is given in table 1.0. The mean population of sesame dominant insect pests recorded on each sesame varieties in the control was higher compared to the treated plots showing a significant pest reduction effect of the bio-pesticidal materials (Rai *et al.*, 2001; Talpur *et al.*, 2002). However, both bio-pesticidal materials gave varied levels of protection to the sesame. The best protection effect was by the positive check, Cypercal® followed by the bio-pesticides Neemix® and Ocimum as evidenced in their low pest populations hosting. This finding agrees with Ahmed *et al.* (2014) and Akinyemi *et al.* (2015). These sesame varieties tend to contribute to this protective effects since individual varieties vary in their pest population responses in relation to the bio-pesticides, Biswass *et al.* (2001); Sintim *et al.* (2010) and Sharma *et al.* (2012) both corroborated this finding.

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

The above effects were noticed also in the harvest index (yield) which appreciated more than in the control. Lower yield is shown by varieties housing higher pest population, suggesting that resistant varieties suffer less insect infestation than the susceptible ones and varieties under high pest pressure resulted to reduced yield components despite effects of the pesticides. Except in one instance where Jatropha seed oil outperformed Neemix ® in E-8, all other treatments gave promising seed yield. Each treatment shows some yield advantage over the control, across all varieties; although their effects are not significantly different. Yield output draw-down could be attributed to infestation by these pests which adversely affect yield as corroborated by Talpur *et al*., (2002).

Some appreciable seed weight gains were recorded among the treatments as against the control in both cropping seasons. 2015 harvested seeds weight was more than those of 2014 cropping season, due probably to weather effects as we recorded higher average temperature and rainfall in this season. The plant population in both varieties was high, thus a promising index of high harvest recorded in the two cropping seasons. Maximally, the number of branches and height evidenced none of the varieties as short variety could be attributed to both the genetic makeup and moisture regime, which was high throughout the cropping seasons.

Since the height was more in Yandev 55 and the lowest recorded in E-8 due likely to genetic variability (Furat and Uzum, 2010; Fazal *et al.*, 2011), this height gives a possibility of lodging. NCRI (2002), classified these varieties to range from non to few lodging but the branching were low except for Yandev 55, which do not agree with the findings of NCRI (2002). Thus higher number of branches gave higher harvest index (Sanipan, *et al*., 2010; Haruna *et al*., 2012).

The stem girth was highest in NCRIBEN-01M in both seasons. Yandev 55 and ICEASE-00018 had the lowest, nevertheless, maintains uniformity, thus the lower incidence of lodging exhibited by the varieties studied.Average numbers of leaves was also high, but uniform across the varieties in both cropping season, hence the appreciable harvest index due to high efficiency of photosynthetic activities, this in conjunction with the leaf area being highest in Yandev 55 and E-8 positively improves plant nutrition and yield performance (Alegbe *et al*., 2011; Haruna *et al*., 2012).

CONCLUSION

The bio-pesticides reduced the number of sesame sucking insect pests with increase seed yield and weight, which were mostly not significantly different between the varieties, exhibiting some level of tolerance. The tolerance factors need however be studied. Impacts of these pests were pronounced in the harvest index of sesame studied, due to evidence of symptoms of devastating diseases across the varieties. The bio-pesticides, though categorized as safe and ecofriendly, gave high level of protection compared to the synthetics, yet, majority show some detrimental effects base on dosage effects and impacts on beneficial insects conservation, therefore needs for caution in use and further studies is most recommended.

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

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ISSN 2053-5805(Print), ISSN 2053-5813(Online)

APENDIX

RESULTS

Table 1.0 Taxonomic status of Economic Pests of Sesame encountered in the study area

S/No.	Common Name	Scientific Name	Family	Order
1.	White flies	*Bemisia tabaci* Gannaeus	Aleyroididae	Homoptera
2.	Sesame Gall Fly	*Asphondylia sesame* Felt	Cecidomyiidae	Diptera
3.	Thrips	*Thrips tabaci* (Lind).	Thripidae	Thysanoptera
4.	Green peach Aphids	*Myzus persicae* (Sulzer)	Aphididae	Homoptera

Source – 2014/2015 Survey

Table 2.0 – Mean population of sesame sucking insects infesting sesame varieties protected with botanical insecticides.

Treatment	Varieties Yandev 55	NCRIBEN-01M	E-8	Ex-Sudan	ICEASE-00018
		2014			
Control	4.34 ± 0.48^{a}	3.49 ± 0.43^{a}	2.88 ± 0.32^{a}	3.73 ± 0.90^{a}	3.88 ± 0.40^{a}
Neemix ®	2.85 ± 0.23^{b}	2.90 ± 0.34^{ab}	2.12 ± 0.29^{a}	2.64 ± 0.43^{ab}	2.82 ± 0.33^{b}
Jatropha	3.04 ± 0.12^{b}	2.55 ± 0.28^{ab}	2.16 ± 0.17^{a}	2.16 ± 0.33^{ab}	2.65 ± 0.28^{b}
Ocimum	2.73 ± 0.33^{b}	2.59 ± 0.34^{ab}	4.86 ± 0.15^{a}	2.79 ± 0.28^{ab}	2.86 ± 0.15^{b}
Cypercal ®	2.20 ± 0.33^{b}	1.98 ± 0.17^{b}	2.23 ± 0.31^{a}	0.19 ± 0.19^{b}	2.22 ± 0.15^{b}
		2015			
Control	5.34 ± 0.82^{a}	3.27 ± 0.32^{a}	3.09 ± 0.42^{a}	3.67 ± 0.76^{a}	3.49 ± 0.53^{a}
Neemix ®	2.54 ± 0.43^{b}	2.95 ± 0.51^{a}	2.36 ± 0.38^{a}	2.48 ± 0.34^{a}	3.38 ± 0.34^{a}
Jatropha	3.27 ± 0.33^{b}	3.05 ± 0.48^{a}	2.29 ± 0.29^{a}	3.16 ± 0.15^{a}	2.36 ± 0.38^{a}
Ocimum	3.39 ± 0.65^{b}	3.09 ± 0.26^{a}	3.03 ± 0.19^{a}	2.44 ± 0.32^{a}	2.99 ± 0.52^{a}
Cypercal ®	2.47 ± 0.77^{b}	2.33 ± 0.44^{a}	2.82 ± 0.11^{a}	2.69 ± 0.41^{a}	2.18 ± 0.29^{a}

Means followed by same letters within a column are not significantly different (P<0.05) at 5% level of significance according to DMRT (Duncan[2])

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

Table 3.0: Sesame yield in Kg/ha^{-1} protected with botanical insecticides against the sesame sucking insects

Treatment	Varieties Yandev 55	NCRIBEN-01M	E-8	Ex-Sudan	ICEASE-00018
2014					
Control	7.62 ± 0.84^{b}	6.99 ± 1.48^{b}	6.67 ± 0.89^{a}	7.20 ± 0.49^{a}	6.27 ± 0.48^{b}
Neemix ®	9.50 ± 0.50^{ab}	11.24 ± 1.20^{a}	9.13 ± 1.06^{a}	7.84 ± 0.97^{a}	7.99 ± 0.53^{ab}
Jatropha	9.61 ± 0.71^{a}	10.22 ± 1.06^{ab}	9.80 ± 0.85^{a}	8.57 ± 0.22^{a}	9.05 ± 0.93^{a}
Ocimum	7.89 ± 0.13^{ab}	9.63 ± 1.46^{ab}	8.16 ± 1.64^{a}	7.85 ± 0.34^{a}	6.62 ± 0.58^{b}
Cypercal ®	9.11 ± 0.47^{ab}	12.33 ± 0.92^{a}	10.25 ± 0.88^{a}	9.12 ± 0.85^{a}	8.89 ± 0.67^{a}
2015					
Control	6.66 ± 0.46^{c}	7.47 ± 1.50^{a}	7.68 ± 0.52^{a}	7.64 ± 1.40^{b}	6.75 ± 0.32^{b}
Neemix ®	9.74 ± 0.85^{b}	11.10 ± 1.75^{a}	8.52 ± 0.54^{a}	10.89 ± 1.25^{ab}	9.15 ± 0.71^{b}
Jatropha	9.43 ± 0.65^{b}	10.65 ± 1.08^{a}	8.84 ± 0.93^{a}	9.54 ± 1.07^{b}	8.09 ± 0.50^{b}
Ocimum	8.22 ± 0.65^{bc}	7.45 ± 0.73^{a}	7.84 ± 1.67^{a}	8.55 ± 0.60^{b}	9.12 ± 0.56^{b}
Cypercal ®	14.54 ± 1.26^{a}	11.22 ± 1.20^{a}	11.44 ± 1.82^{a}	13.96 ± 0.80^{a}	15.50 ± 1.33^{a}

Means followed by same letters within a column are not significantly different (P<0.05) at 5% level of significance according to DMRT (Duncan[2]).

Table 4.0: Mean weight of 1000 seeds of sesame varieties protected with botanical insecticides.

Treatment	Varieties Yandev 55	NCRIBEN-01M	E-8	Ex-Sudan	ICEASE-00018
	2014				
Control	1.29 ± 0.10^{a}	1.18 ±0.72^{a}	1.20 ±0.03^{c}	1.27 ± 0.10^{ab}	1.25 ± 0.02^{c}
Neemix ®	1.56 ± 0.03^{a}	1.23 ± 0.18^{a}	1.55 ± 0.04^{ab}	1.58 ± 0.01^{ab}	1.46 ± 0.03^{ab}
Jatropha	1.63 ± 0.12^{a}	1.47 ± 0.10^{a}	1.44 ± 0.06^{b}	1.51 ± 0.02^{ab}	1.51 ± 0.11^{ab}
Ocimum	1.34 ± 0.11^{a}	1.39 ± 0.17^{a}	1.24 ± 0.03^{c}	1.36 ± 0.15^{b}	1.33 ± 0.07^{bc}
Cypercal ®	1.61 ± 0.11^{a}	1.54 ± 0.02^{a}	1.64 ± 0.02^{a}	1.65 ± 0.06^{a}	1.61 ± 0.05^{a}
2015					
Control	1.36 ± 0.11^{a}	1.32 ± 0.06^{a}	1.17 ± 0.04^{c}	1.22 ± 0.09^{a}	1.30 ± 0.09^{a}
Neemix ®	1.60 ± 0.09^{a}	1.36 ± 0.05^{a}	1.50 ± 0.08^{ab}	1.36 ± 0.13^{a}	1.57 ± 0.12^{a}
Jatropha	1.47 ± 0.12^{a}	1.59 ± 0.07^{a}	1.34 ± 0.09^{abc}	1.44 ± 0.11^{a}	1.46 ± 0.08^{a}
Ocimum	1.42 ± 0.13^{a}	1.43 ± 0.17^{a}	1.23 ± 0.13^{bc}	1.27 ± 0.06^{a}	1.36 ± 0.14^{a}
Cypercal ®	1.62 ± 0.08^{a}	1.61 ± 0.08^{a}	1.54 ± 0.09^{a}	1.40 ± 0.07^{a}	1.60 ± 0.12^{a}

Means followed by same letters within a column are not significantly different (P<0.05) at 5% level of significance according to DMRT (Duncan [2])

ISSN 2053-5805(Print), ISSN 2053-5813(Online)

Table 5.0: Agronomic parameters of sesame varieties observed in weeks after planting.

Varieties	Plant Population	Plant Height (cm) 12WAP	No. of branches tillers at 12WAP	Stem girth cm at 12WAP	Mean no. of leaves 12WAP	Leaf Area 8WAP(cm^2)
			2014			
Yandev 55	7.98 ± 0.34^{bc}	11.66 ± 0.23^{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 ± 0.17^{bc}
E-8	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 ± 0.55^{a}	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}	1.93 ± 0.11^{ac}	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}
E-8	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 ± 0.23^{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 significantly different ($P<0.05$) at 5% level of significance according to DMRT (Duncan[2]).

ISSN 2053-5805(Print), ISSN 2053-5813(Online)