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System Productivity of Sesame Varieties and Seed Rates Intercropping With Millet in the Nigerian Savanna

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Abstract: Field experiment was conducted at the Lake Chad Research Institute, research station Maiduguri (Lat: 11^0 $50^{'}$ N; Long: 13^0 $10^{'}$ E) and Biu (Lat: 10^0 $36^{'}$ N; Long: 12^0 $11^{'}$ E) during 2011 cropping season. The aim was to identify the best sesame variety, optimum sesame seed rate and best system productivity of the crop mixture for the diverse Sudan and Northern Guinea savannah agro-ecologies of Nigeria. Treatments comprised of four sesame varieties (NCRIben 02M, Kenana-4, Ex-Sudan and Gwoza local) at five seed rates (2.0, 3.0, 4.0, 5.0 and 6.0 kg/ha). These were factorially combined and laid out in a Randomized Complete Block Design with three replications. Results showed significant ($P<0.05$) difference among the four intercropped sesame varieties for most of the assessed parameters, in which Ex-Sudan, followed by NCRIben 02M significantly out-yielded the local cultivar, Gwoza local at both locations. The local cultivar took significantly longer days to flower and mature. The highest system productivity for Maiduguri and Biu were obtained when millet was intercropped with Kenana-4 (1.28) at 4.0 kg/ha seed rate and NCRIben 02M (1.29) at 5.0 kg/ha, respectively. However, Ex-Sudan intercrop consistently gave competitive yield advantage (1.26) at 4.0 and 5.0 kg/ha sesame seed rate for Maiduguri and Biu, respectively. In conclusion, millet intercrop with Ex-Sudan is recommended for the broad Sudan and Northern Guinea Savannah belt, at 4.0 and 5.0 kg/ha sesame seed rate, respectively. Sesame Varieties Kenana-4 and NCRIben 02M are recommended for intercropping with millet at seed rates of 4.0 and 5.0 kg/ha specifically for Sudan and Northern Guinea Savannah, respectively.

Keywords*: Millet, Sesame, Seed Rate, Intercropping. Savannah*

1.0 Introduction

System productivity of millet-sesame intercrop could be enhanced by appropriate choice of variety and optimum seed rate. Cereal-legume mixtures have been a traditional practice in the Nigerian Savannah, which serves the crop diversity need of the farmers and insurance against total crop failure (Mortimore *et al*. 1997; Shinggu *et al.* 2009; Shamili *et al.* 2021; Deborah *et al.* 2022). Intercropping is an agricultural intensification strategy proposed to increase food production while addressing some environmental issues (Midmore, 1993). Intercropping systems produce as much as 15–20% of the world's food supply and can increase food security while reducing risk (Javaid *et al.* 2015 and Sagar *et al.* 2020).Thus, adoption of proper intercropping system could play a vital role in increasing the productivity of the associated component crops. The choice of component crop, crop density as well as spatial arrangement, determine the efficiency of land use in an intercropping system (Rowe *et al.* 2005; Zhang *et al.* 2007;Delaquis *et al*. 2018).Past research efforts had been mostly devoted

to the major legumes, groundnut and cowpea, with little or no attention to minor legumes like sesame, especially in culture with millet (Emechebe, 1998 and Nweke, 2018). Sesame is gaining significance in Nigerian agriculture because of its importance as cash crop in the world market. It is an important cash and food crop that is widely cultivated in at least thirteen states of northern Nigeria. There are indications that sesame yield can be enhanced by variety selection, optimum seed rate, under appropriate cropping system (Ali and Omojor, 1998, Kālu and Adeyemo (2009). Although, sesame yields higher when grown under sole crop, higher system productivity (LER) had been reported in mixture (Ali, 1998; JARDA, 1998; Iwo and Idowu, 2002; Sharmili and Parasuraman, 2018; Ajiboola and Kolawale. 2019). More so, the continued cultivation of local cultivars of sesame by farmers, which are low-yielding (400 - 530 kg/ha), and sthe wide range of seed rate used by farmers from as low as 1 - 2 kg/ha and as high as 17 kg/ha seed (Voh, 1998; Katanga and Buba. 2014; Lakew *et al.* 2018) suggest the need for further research. Improved sesame varieties with advantages over farmers' local in terms of higher yield, early maturity, white-brown seed colour and good plant growth characteristics are now available (NCRI, 2009). Thus, there is need to develop an appropriate sesame-millet intercropping system and optimum seed rate that would be most adaptable to intercropping conditions. The objectives of the present study are to identify the variety that does best in the intercrop and determine the optimum seed rate of sesame for intercrop with millet.

2.0 Materials and methods

The field trial was conducted during the 2011 rainy season at Maiduguri (Lat: 11^0 $50^{'}$ N; Long: 13^0 $10^{'}$ E) and Biu (Lat: 10^0 $36^{'}$ N; Long: 12^0 $11^{'}$ E) in Sudan and northern Guinea Savannah agro-ecological zones of Nigeria, respectively. Soils, rainfall and temperature were the major discriminating factors among the locations. Soil types of the two respective locations are sandy loam and clay loam, and meteorological information indicate that total annual rainfall for the year at Maiduguri and Biu were 330.6 mm and 812.4 mm, while rainfall received during the trial period were 266.1 mm and 587.2 mm, respectively. Mean annual temperature at the Maiduguri and Biu locations were 30.0±1.10 ^{0}C and 27.5±0.46 ^{0}C, with recorded effective temperature during the growth period of 29.8±0.84 ^{0}C and 27.9±0.58 ^{0}C, respectively.

2.1 Experimental Site Description

The experiment was laid out in randomized complete block designed (RCBD) replicated three times. Four sesame varieties NCRIben 02M, Kenana 4, Ex-Sudan and Gwoza local and five seed rates 2.0, 3.0, 4.0, 5.0 and 6.0 kg/ha), four sole of sesame and a sole of millet (SOSAT C-88) were obtained by factorial combination Plot size of 6.0 m x 6.0 m (36.0 m^2), in which each plot comprised of eight rows spaced at 0.75 m apart; while the net plot had four rows of 6.0 m x 3.0 m (18.0 m^2).

The site was prepared with a tractor-driven harrow; both seeds of sesame and pearl millet were separately dressed with Apron Star 42 WS at rate of one sachet (10 g) to 3 kg of seeds. Both pearl millet and sesame were simultaneously sown on flat on 15th and 22nd July, 2011 at Maiduguri and Biu at 2: 1 respectively. The pearl millet component received 30 kg N, 30 kg 205 and 30kg K_20 ha^{-1} two weeks after sowing (WAS) nitrogen, second dose of 30kg N/ha was applied at 5 WAS using urea (46%). The recommended rate of 20 kg N, 30 kg P_2O_5 and 30 kg K_2O/ha was applied to sesame half dose of N and all P and K were applied at planting, while the remaining half dose of N (10 kg) was top dressed using urea (46%) sesame at 6 weeks after sowing (NOMA, 2002). All plots were manually hoe- weeded at 3 and 6 WAS. Harvesting was done manually after the crops have matured and dried the pearl millet was first harvested and sesame was harvested later. Agronomic and yield data were collected and the benefit of intercropping was assessed using land equivalent ratio (Mead and Willey 1980), as the relative land area under sole crops that is required to produce the yields achieved by intercropping under the same level of management conditions.

Mathematically, LER was computed as:

$$LER = Ym/Ysm + Ys/Yss$$

Where:

LER = Land equivalent ratio

Ym = Yield of pearl millet in intercrop

Ysm = Yield of sole pearl millet

Ys = Yield of sesame in intercrop

Yss = Yield of sole sesame

2.2 Data collection

All data collected were subjected to analysis of variance (ANOVA) with the help of statistical software, Statistix 8.0. The treatment means were compared using Least Significant Difference (LSD at 5% level of probability when F –Value were significant (Gomez and Gomez, 1984).

3.0 Results and Discussion

Table 1 results of rainfall received during the growth in Maiduguri (266.1 mm) could therefore be termed low, whereas that at Biu (587.2 mm) was twice as much and exceeds the minimum rainfall requirement for effective crop performance (table1). Sesame thrives well where rainfall is as low as 400 mm per annum (Kolo and Daniya, 2006; Hussain *et al.* 2020). Similarly, growth environment temperature at Maiduguri (29.8±0.84 ^{0}C) was relatively higher than at Biu (27.9±0.58 ^{0}C). Thus, the high productivity from system with sesame at Biu could be attributed to the relatively higher rainfall and lower temperature, which further enhanced the performance of the variety NCRIBEN 02M that has the highest grain weight. Previous reports had also observed differences in sesame and millet performance to climatic factors and attendant biotic factors of pests and diseases (Hudu, 2000; Gworgwor *et al.* 2001; Altinok *et al.* 2005; Rouamba, *et al*. (2021) The result also show better performance of the millet component at Maiduguri and the sesame component at Biu, suggesting further difference in the adaptation of the component crop. Earlier reports had linked the high performance of millet in the Sudan Savannah to drought tolerance and low incidences of pest and diseases on one hand, while rainfall regime in Guinea Savannah is beneficial to sesame on the other hand (Dugje, 2004; Desai and Pujari, 2007; Kalu and Adeyemo, 2009; Osabohien and Ogunbiyi. 2019).

Table 1: **Mean Monthly Rainfall and Temperature for Maiduguri and Biu, 2011**

	Rainfall (mm)		Temperature (^{0}C)	
Month	Maiduguri	Biu	Maiduguri	Biu
April		30.00	35.15	26.24
May		49.80	35.35	29.39
June	64.50	145.40	33.71	29.67
July	60.25	231.40	30.99	27.94
August	157.50	191.9	27.71	27.58
September	45.00	106.20	29.20	26.64
October	3.25	57.70	31.28	29.36
Total Recorded	330.6	812.40	30.00	27.5
Cropping period	266.1	587.20	29.80	27.9

Sources: Lake Chad Research Institute, Automatic weather station and Ministry of Agriculture, Department of Meteorological services Biu.

The effect of intercropping on millet growth and yield parameters at Maiduguri and Biu are presented in (Table 2). Results showed that intercropping had significant effect on growth and yield parameters of millet accept stand count and days to Physiological maturity at Biu and Maiduguri. The stand count ranged from 14-15 and 10-11 with mean of 14 and 11 at Maiduguri and Biu respectively. The number of days to 50% flowering days ranged from 63-65 and 63-67 with mean of 63 and 64 at Maiduguri and Biu respectively. Plant height ranged 264.9-282.4 and 191.7-200.9 cm with mean of 275.3 and 196.0 cm at Maiduguri and Biu respectively. The physiological maturity days ranged from 77 and 78-79 days with mean of 77 and 78 days at Maiduguri and Biu respectively. Grain yield varied from 1686 – 1992 and 1188 – 1269 at Maiduguri and Biu respectively. The result showed better performance of the

millet component at Maiduguri than Biu this could be attributed to difference in the adaptation to environmental factors of the component crop millet to drought tolerance and low incidences of pest and diseases in Sudan Savannah. Previous reports had also observed differences in sesame and millet performance to climatic factors and attendant biotic factors of pests and diseases (Hudu, 2000; Gworgwor *et al.*, 2001; Altinok *et al.,* 2005; Rouamba, *et al*. (2021).The effect of sesame seed rate on the number of days to 50% flowering, Plant height, number of days to physiological maturity and yield were not significant at both locations. Interaction of seed rate to the variety was not significant.

Table 2: Effect of stand count, days to 50% flowering, plant height and days to maturity of sesame millet intercrop with millet/sesame seed rate on the growth parameters of Sesame during 2011 cropping season.

Treatments	Stand count		Days to 50% flowering		Plant height (cm)		Days to maturity		Grain yield kg/ha)	
	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu
Intercrops(I)										
SOSAT-C88 + NCRIben 02M	14	11	63	63	275.6	199.7	77	78	1836.6	1207.1
SOSAT-C88 + Kenana-4	15	10	63	63	282.4	200.9	77	78	1991.8	1268.9
SOSAT-C88 +Ex-Sudan	14	10	63	63	264.9	191.7	77	79	1685.7	1207.4
SOSAT-C88 +Gwoza local	14	10	65	67	278.5	191.7	77	78	1824.9	1188.0
Mean	14	11	63	64	275.3	196.0	77	78	1834.8	1217.9
LSD(0.05)	0.4	NS	1.4	1.4	10.0	3.0	NS	0.9	45.6	30.8
Seed rate (S) kg/ha	SE		0.7	0.6	4.9	1.5	0.9	0.4	22.6	15.3
1.0	11	10	63	62	271.6	190.0	75	78	2021.4	1150.1
2.0	11	11	63	63	273.5	195.7	76	79	1861.0	1046.1
3.0	10	11	63	64	275.5	188.6	77	79	1928.8	986.3
4.0	10	11	66	68	280.0	189.3	76	80	1674.2	1143.5
5.0	11	11	63	65	277.0	195.8	77	77	1893.8	1073.8
6.0	33	11	63	61	274.4	216.6	77	77	2629.3	1907..3
Mean	11	11	63	64	275.3	196.0	77	78	1834.3	1217.9
LSD 0.05	0.5	NS	1.7	1.5	1.5	3.7	NS	1.1	55.8	37.8
Interaction	SE		0.9	0.7	6.0	1.9	1.1	0.5	27.7	18.8
I X S	*	NS	*	*	*	*	NS	*	*	*

KEY: ***Variety:*** *V_1=NCRIBEN 02M x Millet (SOSAT-C88), V_2=Kenana-4 x Millet (SOSAT-C88), V_3=Ex-Sudan x Millet (SOSAT-C88), V_4=Gwoza local x Millet (SOSAT-C88)* ***Seed rate:*** *R_1 = 2.0 kg/ha, R_2 = 3.0 kg/ha, R_3 = 4.0 kg/ha, R_4 = 5.0 kg/ha, R_5 = 6.0 kg/ha.*

The effect of intercropping sesame seed rate on growth and yield parameters at Maiduguri and Biu is presented in (Table 3). Results showed significant differences in all the parameter studied in both locations except plant height at Maiduguri location. Stand count ranged from 83 – 107 and 134 – 163 with means of 94 and 150 respectively. The number of days to 50% flowering ranged from 44 - 52 and 45 - 52 with means 46 and 47 at Maiduguri and Biu respectively. Millet grown in combination with Gwoza local took significantly longer number of days attained 50 % flowering compared to other improved sesame varieties grown in combination with millet The variety Gwoza local took significantly longer time to flower than the other varieties at both locations this could be due to adverse climatic conditions and poor genetic traits as reported by (Omojor, 1998; Kolo and Daniya, 2006; Hussain *et al.* 2020).Plant height ranged from 196.5 – 121.6 with means of 138.2 and 141.1 at Maiduguri and Biu locations. The number of days to physiological maturity ranged from 83 - 125 and 87– 130 with means 94 and 98 at Maiduguri and Biu respectively. The local sesame cultivar (Gwoza local) grown in combination with millet took more number of days to attained physiological maturity compared to improved varieties grown in the mixture with millet. Millet intercropped with Kenana-4 and NCRIben 02 was comparably taller than with Ex-Sudan at Maiduguri and Biu. However, there was no significant difference in the heights of millet grown in association with other improved sesame varieties at Maiduguri but significant at Biu location. This could be attributed to adverse competition effects of the taller and earlier sown millet component on the later intercropped shorter sesame crop (Ong, 1996 and Rowe *et al*. 2005, Adieniyan *et al.* 2014, Asiimwe *et al.*, 2016, Delaquis *et al*. 2018)) Observed that space and shading effects, coupled with competition for soil and water resources are main causes for low productivity of under crops. The effect of sesame seed rate on Interaction of seed rate to the variety was significant. This could be attributed to varying seed rate and timing of sowing as reported by (Enwezor *et al.* 1989, Iwo and Idowu., 2002) and FAO, 2004). Interaction was significant in stand count, days to flowering, plant height and maturity (Delaquis *et al*. 2018)

Table 3. Effect of stand count, days to 50% flowering, plant height and days to maturity of Sesame Intercrop with millet/sesame seed rate on the growth parameters of Sesame during 2011 cropping season.

Treatment	Stand count		Days to 50% flowering		Plant height (cm)		Days to maturity	
	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu
Intercrop (I)								
SOSAT-C88 + NCRIben 02M	83	134	46	46	121.6	141.9	85	87
SOSAT-C88 + Kenana-4	87	160	44	46	196.5	141.6	83	87
SOSAT-C88 +Ex-Sudan	107	142	44	45	117.5	142.2	84	87
SOSAT-C88 +Gwoza local	99	163	52	52	117.7	138.6	125	130
Mean	94	150	46	47	138.2	141.1	94	98
LSD 0.05	3.0	3.1	1.5	0.4	NS	2.2	1.0	0.3
Seed rate (S) kg/ha								
1.0	74	169	45	46	112.1	143.8	84	87
2.0	71	128	45	47	113.6	142.7	85	88
3.0	95	129	47	46	113.0	137.5	85	87
4.0	91	151	47	46	115.3	142.2	85	87
5.0	99	166	46	47	116.3	143.6	85	87
6.0	137	157	48	49	119.6	137.1	87	88
Mean	94	150	46	47	138.2	141.1	94	98
LSD 0.05	3.6	0.5	1.1	0.5	NS	2.7	1.2	0.4
Interaction								
I X S	*	*	*	*	*	*	*	*

KEY: ***Variety:*** *V_1=NCRIBEN 02M x Millet (SOSAT-C88), V_2=Kenana-4 x Millet (SOSAT-C88), V_3=Ex-Sudan x Millet (SOSAT-C88), V_4=Gwoza local x Millet (SOSAT-C88)* ***Seed rate:*** *R_1 = 2.0 kg/ha, R_2 = 3.0 kg/ha, R_3 = 4.0 kg/ha, R_4 = 5.0 kg/ha, R_5 = 6.0 kg/ha.*

The effect of intercropping sesame seed rate on yield and yield components at Maiduguri and Biu are presented in (Table 4). Results showed significant differences in all the parameter studied except 1000 test weight interaction at Biu location. Number of branch per plant ranged from 4 – 5 and 3 - 6 with mean of 5 and 4 at Maiduguri and Biu respectively. The varieties Ex-Sudan and Gwoza local had more number of branches than the other improved sesame varieties in both locations. However, in Biu, Gwoza local gave significantly higher number of branches than all other varieties. Number of capsule per plant ranged from 9 – 15 and 70 – 98 with mean of 12 and 87 at Maiduguri and Biu respectively. The Ex-Sudan gave significantly more capsules than all the tested varieties followed by NCRIben 02M while the least was recorded from Kenana -4 and Gwoza local. The varieties NCRIben 02M recorded the highest 1000 seed weight followed by Gwoza local and the lowest from Ex – Sudan and Kenana - 4 at Maiduguri while at Biu was not significant. The Grain yield ranged from 119.2 – 360.0 and 315.8 - 503 kg/ha with means of 223.2 and 421.6 kg/ha at Maiduguri and Biu respectively. There was significant differences among the sesame varieties grown in mixture with millet at both locations. The variety, Ex-Sudan significantly recorded the highest grain yield followed by NCRIben 02M and the least from Gwoza local in both locations. This could be attributed to number of branches per plant, number of capsule per plant, 1000 seed weight (Patra, 2001; Okpra *et al*. 2007; Shehu *et al*. 2010). There was significant interaction between numbers of branches, capsules number; test weight at both locations except Biu test weight was not significant

Table 4. Effect of intercropping millet/sesame and Seed Rate on the Yield and Yield components of Sesame during 2011 cropping season.

Treatment	Number of branch/plant		Number of capsule/plant		1000 test weight (g)		Grain yield (kg/ha)	
	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu
Intercrop (I)								
SOSAT-C88 + NCRIben 02M	5	4	15	97	4.0	4.0	237.8	465.8
SOSAT-C88 + Kenana-4	4	3	9	70	3.8	4.0	175.6	401.6
SOSAT-C88 +Ex-Sudan	5	4	17	98	3.8	4.0	360.0	503.1
SOSAT-C88 +Gwoza local	4	6	9	81	3.9	4.0	119.2	315.8
Mean	5	4	12	87	3.9	4.0	223.2	421.6
LSD 0.05	1.0	0.3	0.5	2.6	0.1	NS	2.6	8.7
Seed rate (S) kg/ha								
1.0	6	4	11	68	3.8	4.0	118.8	393.3
2.0	3	5	8	69	4.0	4.0	258.2	333.2
3.0	4	4	15	92	3.9	4.0	222.2	390.4
4.0	5	4	15	84	4.0	4.0	287.2	458.2
5.0	4	4	13	90	3.8	4.0	221.7	491.9
6.0	6	7	13	117	3.9	4.0	230.1	462..9
Mean	5	4	12	87	3.9	4.0	223.2	421.6
LSD 0.05	1.1	0.3	0.6	3.2	0.1	NS	3.2	10.6
Interaction								
I X S	*	*	*	*	*	NS	*	*

3.1 Mixture Productivity and Land Equivalent Ratio (LER)

Table 5 showed the results of Land Equivalent Ratio (LER) computed that intercropping caused yield reduction in both locations. The highest reduction for sesame was in Maiduguri compared with Biu. However, the combined LER of millet and sesame intercrop exceeded the sole crop performance in both locations. Similar advantage of more effective land utilization has been reported with sorghum/soybean Mead and Willey, 1980; Dhima *et al.*

2007; Mohammed, et *al.* 2000; Delaquis *et al*.2018). Results from comparison of the mixture grain yield of the component crops with sole crops indicated that increasing millet seed rate in the mixture resulted in an increased in the LER of millet while LER of sesame decreased with increase in its seed rate in both locations. Sesame seed rate 4.0 kg/ha and 5.0 kg/ha (millet/sesame) produced the highest yield advantage of 42 and 27 percentage in both locations respectively, reflecting superiority of this mixture to sole cropping of either millet or sesame. This agrees with earlier reports that yield increased with plant population, and high planting density suppressed weed better, but these benefits on yield decreased after reaching a certain point (Busari *et al.* 1998; Ndarubu *et al.* 2003; Imoloame *et al.* 2004).

Table 5: Relative productivity of millet/sesame mixture (Land Equivalent Ratio) at Maiduguri and Biu, 2016 rainy season

Treatment	Millet yield kg/ha		Sesame yield kg/ha		Partial LER Millet		Partial LER Sesame		Total LER	
	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu	Maiduguri	Biu
V_1R_1	5445	3389	382	1164	0.79	0.59	0.26	0.58	1.05	1.17
V_1R_2	5333	2843	444	999	0.77	0.50	0.31	0.50	1.08	1.00
V_1R_3	6222	2941	333	889	0.90	0.51	0.23	0.44	1.13	0.95
V_1R_4	4889	3721	556	1221	0.71	0.65	0.39	0.61	1.10	1.27
V_1R_5	6222	3111	444	1000	0.90	0.54	0.31	0.50	1.21	1.04
V_2R_1	7445	3233	382	833	1.08	0.57	0.34	0.39	1.42	0.96
V_2R_2	6888	3333	278	629	1.00	0.58	0.25	0.31	1.25	0.89
V_2R_3	6111	4055	278	944	0.89	0.71	0.25	0.45	1.14	1.16
V_2R_4	5111	3112	402	1223	0.74	0.54	0.36	0.58	1.10	1.12
V_2R_5	6000	3386	382	1056	0.87	0.59	0.34	0.50	1.21	1.09
V_3R_1	5556	3678	218	1167	0.81	0.64	0.14	0.55	0.95	1.20
V_3R_2	5556	2889	216	1111	0.81	0.50	0.13	0.53	0.94	1.03
V_3R_3	5222	2223	278	1389	0.76	0.39	0.17	0.66	0.93	1.05
V_3R_4	4455	3889	611	1111	0.65	0.68	0.38	0.53	1.04	1.08
V_3R_5	4666	3333	382	1389	0.68	0.58	0.25	0.66	0.93	1.24
V_4R_1	5789	3501	556	1056	0.84	0.61	0.27	0.49	1.11	1.11
V_4R_2	5890	3488	444	1056	0.86	0.61	0.22	0.49	1.08	1.10
V_4R_3	5555	2667	556	1167	0.81	0.47	0.27	0.54	1.08	1.01
V_4R_4	5778	3000	556	1289	0.84	0.52	0.27	0.60	1.11	1.12
V_4R_5	6000	3056	666	1277	0.87	0.53	0.32	0.59	1.19	1.12
Sole Millet	6888	5722			1	1				
Sole V_1			1444	2000			1	1		
Sole V_2			1122	2111			1	1		
Sole V_3			1611	2111			1	1		
Sole V_4			2056	2166			1	1		

KEY: ***Variety:*** *V_1=NCRIBEN 02M x Millet (SOSAT-C88), V_2=Kenana-4 x Millet (SOSAT-C88), V_3=Ex-Sudan x Millet (SOSAT-C88), V_4=Gwoza local x Millet (SOSAT-C88)*

Seed rate: *R_1 = 2.0 kg/ha, R_2 = 3.0 kg/ha, R_3 = 4.0 kg/ha, R_4 = 5.0 kg/ha, R_5 = 6.0 kg/ha.*

3.3 Conclusion and recommendation

In conclusion, millet intercropping with Ex-Sudan is recommended for the broad Sudan and Northern Guinea Savanna belt, at 2.0 and 4.0 kg/ha sesame seed rate, respectively. Thus, while Kenana-4 and NCRIBEN 02M expressed specific adaptation for intercropping in Maiduguri and Biu, respectively, Ex-Sudan showed adaptation in guinea savannah.

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