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GROWTH AND YIELD OF GROUNDNUT (*Arachis hypogea* (L.)) AND MAIZE (*Zea mays* (L.)) AS INFLUENCED BY INTERCROP RATIO IN YOLA, ADAMAWA STATE.

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Abstract: **Field experiments were conducted at the Teaching and Research Farm of the Department of Crop Production and Horticulture, Modibbo Adama University of Technology, Yola during the 2009 and 2010 raining seasons to study the effects of intercropping ratio on the growth and yield of groundnut- maize inter-cropped. Treatments consisted of four intercropping ratio (1:1, 2:1, 2:2, and 3:2) while 1:1 is one row of groundnut alternated with one row of maize, 2:1 is two rows of groundnut alternated with one row of maize, 2:2 is two rows of groundnut alternated with two rows of maize and 3:2 is three rows of groundnut alternated with two rows of maize arranged in a split plot design and replicated three times. Parameters measured includes: number of branches and number of leaves/plant, plant height, stem and cob diameter, number of pods/plant, 100 pods and seed weight/plot, weight of ears/plot, 100 grain weight/plot and seed and grain yield/hectare, forage and stover weight/plot, were measured. The result of the study show that there were significant differences among the intercropping ratio on growth parameters measured. Stem diameter and bunch height shows significant influence due to intercropping pattern. Yield parameters such as number of pods/plant and cob diameter were significant at p≤0.01 by intercropping ratio. Based on the result obtained it shows that groundnut – maize intercropped ratio of 2:2 and 3:2 gave the optimum yield in the two years study in Yola. Farmers in Yola and its environs are therefore advised to adopt 2:2 and 3:2 groundnut – maize intercropped ratio for optimum pod, seeds and grains yield of groundnut and maize.**

Keywords: **Growth, yield, intercrop and ratio.**

I. INTRODUCTION

Groundnut is a short herbaceous annual that produces its pods inside the soil. Groundnut was brought to West Africa through the slave trade, which is believed to originate from South America (Bababe, 1991). Nutritionally, groundnut have high content of edible oil (50%) and protein (25%) makes it a popular human food, it is consumed either as shell nut or as oil. After pressing of the kernel, groundnut can be used as an enriching ingredient in a wide range of cooked dishes (Freeman *et al.,* 1999). Groundnut has immensely contributed to the development of Nigeria up to 1969 before the oil boom of the early 1970's resulted in near complete neglect of the agricultural sector (Parr, 1983). Nigeria is third largest exporter of groundnut in the world after India and China (Raw Materials Research and Development Council, 2004),

Maize is a tall to medium short grass plant with a strong solid stem carry large narrow leaves in an alternate form. It is believed to have originated from Mexico or Central America. Maize is a plant which can be grown on wide variety of soil ranging from fairly course loam and a very diverse kinds of soil of heavy clay (Okigbo, 2000). Maize is the most important cereal in the world (Encyclopedia, 2006) which is used mainly as food for human, feed for livestock and raw materials for industries (FAO, 2004)

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Intercropping is a popular cropping system among small size farmers in the tropics (Vandemeer, 1992). Intercropping groundnut with maize would be advantageous to the small scale farmers in terms of increased maize yields, higher combined crop yield/ ha, increased weed suppression and possibly improve soil enrichment and more nutrients. For this, small scale farmers are encouraged to sow maize with groundnut (Edje and Osiru, 1988). Maize grain were increased by 20% following maize legume intercropping (Nygren, 1994).

Farmers grow several crops simultaneously, and to grow groundnut in pure stands leading to low level of 690 kg/ha of groundnut yield (Okigbo, 2000). Adoption of intercropping groundnut / cereal production is a viable option. However, the economic benefits of this farming practice to the local groundnut farmer are yet to be established. The economic implication of intercropping groundnut with maize to the farmer will be investigated in this study.

II. METHODOLOGY

The experiment was conducted at the Teaching and Research Farm of the Department of Crop Production and Horticulture, MAUTECH, Yola, Adamawa State. Yola is located within latitude 9^0 19'N and longitude 12^0 30' E of the equator at an altitude of 185.9 M above sea level, and lies within the Northern Guinea Savanna ecological zone of Nigeria. The mean annual rainfall is 900 mm -1100 mm and the length of the rainy season ranges from 150-160 days, mostly from April to October (Adebayo and Tukur, 1991). The annual maximum temperature of the area is 42^0 C (ADADP, 2001)

The field trial was split plot design replicated three times, with uniform plot size of 4 x 4 m to accommodate the experiment. The experiment made use of two crops namely: groundnut and maize. Four weeding frequencies were assigned to the main plot. The intercropping pattern was assigned to sub plot and replicated three times. Data collected for groundnut are number of branches, bunch height in cm, number of pods per plant, dry weight of 100 pods (g), 100 seed weight (g), seed yield (kg/ha) and forage weight (g). Data collected for maize includes: plant height, number of leaves /plant, stem diameter (cm), cob diameter (cm), weight of ears/plot (g), 100 grain weight (g), grain yield (kg/ha) and Stover weight/plot (g). Weed parameters includes: weed density and weed dry weight (g). Data collected was subjected to analysis of variance (ANOVA) appropriate to split plot design. Means were separated using Duncan's multiple range test (DMRT) to determine the means at 5% probability level.

III. RESULTS AND DISCUSSION

Table 1: Mean effect of number of branches at 3, 6, 9 and 12 WAS in 2009 and 2010 raining seasons

Treatment	Number of branches											
	3 WAS			6 WAS			9 WAS			12 WAS		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
Intercropping												
1:1	3.72c	3.55a	3.63b	5.03b	5.60c	5.17c	5.80b	6.40b	6.10c	5.80c	6.45c	6.20b
2:1	4.33ab	4.28a	4.21a	6.21a	6.06b	5.86b	7.97a	7.36a	7.18b	7.01b	7.62ab	7.25b
2:2	4.56a	5.69a	4.51a	6.81a	6.61a	6.35a	7.00a	7.57a	7.04a	7.06a	7.97a	7.50a
3:2	4.41a	4.72a	4.40a	6.72a	6.79a	6.47a	7.17	7.78a	7.79a	7.20a	8.30a	8.20a
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

KEY

WAS = Weeks after sowing

1:1 = 1 groundnut row alternated with 1 maize row

2:1 = 2 groundnut rows alternated with 1 maize row

2:2 = 2 rows of groundnut alternated with 2 maize rows

3:2 = 3 rows of groundnut alternated with 2 maize rows

NS = not significant

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The mean effect of the treatment on number of branches /plant with regard to intercropping pattern in 2009 and 2010 raining seasons as shown in table 1. In 2009 raining season, at 3 WAS, 2:2 produced the highest number of b ranches (4.56) while 1:1 has the lowest number of branches (3.72). At 6 WAS, there was no significant difference at $p \leq 0.05$ except at 1:1 which recorded lowest mean value of 5.03, while at 9 WAS 3:2 and 2:2 gave the highest number of branches which recorded 7.17 and 7.01 respectively. The least number of branches was recorded at 1:1. In 2010 raining season, at 3 WAS 2:2 gave highest number of branches (5.69) and 1:1 had least number of branches (3.55). significant differences was also observed at 12 WAS at $P \leq 0.01$ where 3:2 produced higher number of branches (8.30) and 1:1 recorded lower number of branches (6.45). The significant effect of intercropping pattern of 2:2 and 3:2 through shading and smothering of weeds may promote intercepting more solar radiation which is crucial factor for photosynthesis processes in the growth and development of crops as recorded by Nygren (1994) that canopy structure promote plants productivity.

Table 2: Mean effect of bunch height (cm), number of pods /plant and 100 pods weight /plant in 2009 and 2010 raining seasons

Treatment	Bunch height (cm)			Number of pods /plant			100 pods weight/plot (g)		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
Intercropping									
1:1	28.29b	25.17c	26.85c	10.23c	9.95c	10.09c	45.20b	45.56c	45.78c
2:1	29.98a	29.27b	29.38b	24.21b	28.04b	26.12b	70.47a	64.56b	68.12b
2:2	31.08a	31.11a	31.10a	37.18a	36.40a	36.79a	89.47a	89.59a	68.93a
3:2	30.86a	30.95a	30.81a	37.48a	41.33a	39.40a	88.27	90.56a	89.02a
Interaction	NS	NS	NS	NS	NS	NS	NS	NS	NS

KEY

1:1 = 1 groundnut row alternated with 1 maize row

2:1 = 2 groundnut rows alternated with 1 maize row

2:2 = 2 groundnut rows alternated with 2 maize rows

3:2 = 3 groundnut rows alternated with 2 maize rows

NS = not significant

Table 2 shows the mean effect of the treatment on bunch height in 2009 and 2010raining seasons. The tallest bunch height of 31.08 cm was recorded at 2:2 followed by 30.86 cm recorded at 3:2 and 2:1 produced the shortest bunch height of 28.29 cm in 2009 raining season. While in 2010 raining season, the same trend was observed at 9 WAS where 2:2 recorded the tallest bunch height of 31.11 cm, 3:2 had 30.95 cm, 2:1 recorded 29.27 cm and the shortest bunch height was recorded at 1:1 with the value of 25.17 cm. Chaud (2000) reported that intercropping groundnut with maize would be advantageous to the small scale farmer in terms of increased maize yields, higher combined crops yield/ha and increased weed suppression.

Table 2 shows mean effect of the treatment on number of pods/plant in 2009 and 2010 raining seasons. In 2009 raining season, intercropping ratio on number of pods indicated that no significant difference ($p \leq 0.05$) among the intercropped ratio. In 2010 raining season, 3:2 had the highest number of pods/plant (41.33) followed by 2:2 (36.40). The least number of pods/plant was recorded at 1:1 (9.95). There was an increase in number of pods per plant with intercropped ratio of 2:2 and 3:2 (two and three groundnut rows alternated with two rows of maize). Plots that were intercropped 2:2 and 3:2 in 2009 and 2010 raining seasons produced the highest number of pods per plant where as plots that were intercropped 1:1 and 2:1 had lower number of pods per plant. Taylor (1998) reported that proper intercropping pattern significantly increase yield in legumes and cereals as more nutrient mobilization via cation exchange capacity and nitrogen fixation increases.

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The effect of 100 pods weight in 2009 and 2010 raining seasons are presented on Table 2. Intercropping ratio in 2009 shows that 2:2 gave the highest 100 pods weight (89.47 g) followed by 3:2 with the value of 88.27 g while 1:1 gave the lowest 100 pods weight with the value of 45.20 g. In 2010 raining season, 3:2 had 90.56 g while 1:1 produced the lowest 100 pods weight with the value of 45.56 g. An intercropped ratio of 2:2 and 3:2 that produced the highest 100 pods weight might be as a result of proper intercropped ratio which suppressed weeds from the plots.

Effect of intercropping ratio for 100 seeds weight (g) are presented in Table 3. The mean intercropping ratio in 2009 shows that 3:2 gave the highest 100 seeds weight (57.60 g) followed by 2:2 with the value of 54.41 g. the lowest 100 seeds weight was obtained at intercropped ratio of 1:1 with the value of 21.31 g. In 2010 raining season, 3:2 had 100 seeds weight of 57.50 g while 1:1 produced the lowest 100 seeds weight (32.38 g). The result indicated that 2:2 and 3:2 intercropped ratio produced the highest 100 seeds weight during the two years raining seasons (57.60 g and 54.41 g respectively). This agrees with the findings of Okigbo and Lah (2007) that relatively simple intercropping systems as groundnut and maize will result in highest interaction between weeding frequency and intercropped.

The effect of the treatment on seed yield per hectare in 2009 and 2010 raining seasons are presented on Table 3. Among the intercropping ratio, 3:2 and 2:2 had the highest seed yield with the value of 527.79 kg and 520.41 kg respectively while 1:1 gave the lowest seed yield of 173.40 kg in 2009 raining season. In 2010 raining season, 3:2 also recorded the highest seed yield (587.25 kg) while 1:1 intercropped ratio produced the lowest seed yield of 173.50 kg. This agrees with the findings of Chaud (2000) who reported that intercropping groundnut with maize would be advantageous to the small scale farmers in terms of increased maize yields, higher combined crops yield per hectare and increased weed suppression.

Table 3: Mean effect of 100 seed weight/plot (g), seed yield/ha (kg) and forage weight /plot (g) in 2009 and 2010 raining seasons

Treatment	100 seed weight/plot (g)			seed yield/ha (kg)			forage weight /plot (g)		
	2009	2010	Mean	2009	2010	Mean	2009	2010	Mean
Intercropping									
1:1	21.31c	32.38b	26.32c	173.40c	173.50c	172.45b	34.55c	35.83c	35.19c
2:1	38.50b	34.23b	33.24b	228.12b	223.70b	225.91b	84.59b	72.23b	73.91
2:2	54.41a	51.21a	52.81a	520.41a	470.16a	495.26a	120.93a	144.08a	140.50a
3:2	57.60a	57.50a	57.55a	527.79a	587.25a	564.10a	130.94a	137.82a	136.68a
Interaction	NS	NS	NS	NS	NS	NS	NS		

KEY

1:1 = 1 groundnut row alternated with 1 maize row

2:1 = 2 groundnut rows alternated with 1 maize row

2:2 = 2 groundnut rows alternated with 2 maize rows

3:2 = 3 groundnut rows alternated with 2 maize rows

NS = not significant

Table 3 shows effect of intercropped ratio on forage weight in 2009 and 2010 raining seasons. In 2009 raining season, 3:2 gave the highest forage weight of 130.94 g while 1:1 gave the lowest forage weight of 34.55 g. In 2010 raining season, 2:2 had 144.08 g with the lowest forage weight from 1:1 intercropped ratio with value of 35.83 g. The highest forage weight obtained at intercropped ratio of 3:2 and 2:2 in the two years cropping seasons indicated that the intercropped ratio of 3:2 and 2:2 is recommended for proper growth of groundnut. Vandemeer (1992) stated that the groundnut–maize intercropped is recommended.

IV. CONCLUSION

Based on the findings of the research, it is concluded that intercropped ratio of 2:2 and 3:2 had significant effect on groundnut-maize intercropped ratio on growth and yield of groundnut. Intercropped ratio suppressed weeds and enhanced groundnut growth. Intercropping groundnut and maize would increase yields of groundnut in respective of their spatial arrangement of the intercropped pattern.

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