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Effect of Intercropping on the Growth and Yield of Cucumber (*Cucumis sativus* L.) and Okra (*Abelmoschus esculentus* L.) Moench

OFOSU-ANIM[1], J. AND N.V. LIMBANI†
Institute of Rural Science, University of Wales, Aberystwyth SY23 3AL, Wales, UK
†*Department of Crop Science, University of Ghana, P.O. Box 44, Legon, Ghana*
[1]Corresponding author's e-mail: aweze2002@yahoo.co.uk

ABSTRACT

A field study was undertaken to investigate the growth and yield of cucumber and okra grown in an intercropped system. Okra as 1-row or 2-row was intercropped with cucumber. Sole cropping of okra resulted in higher number of fruits plant^{-1}, yield plant^{-1} and yield hectare^{-1} though the differences in these values and 1-row okra intercrop were not significant. Intercropping okra with cucumber resulted in reduced weed infestation, especially of broadleaf weeds. Land equivalent ratio (LER), 2.4 and 2.2 for one row okra and two rows okra intercrop, respectively showed that intercropping was more beneficial than sole cropping.

Key Words: Cucumber; Okra; Intercropping; Growth; Yield

INTRODUCTION

Interplanting of crops by smallholder and peasant farmers has been a common practice throughout the years. Mono-cropping or pure stands have been emphasized, because of its advantages (Anderson *et al.*, 1980; Gondwe, 1992). Despite the advantages of mono-cropping almost all smallholder or peasant farmers in the developing world still practice intercropping. This practice may allow complementary interactions in crops that have greater system resilience (Theunissen, 1997; Wolfe, 2000) greater production at crop edges (Ghaffarzadeh *et al*., 1997) reduce insect-pest incidence (Theunissen & Schelling, 1996; Ramert, 2002) reduce disease transfer (Finckh & Wolfe, 1997; Garrett & Mundt, 1999; Wolfe, 2000) and deliver environmental benefits such as greater soil and water conservation potential (Gilley *et al*., 1997; Theunissen, 1997; Poudel *et al*., 1999; Gilley *et al*., 2002).

Intercropping is practiced with the aim of maximizing plant cooperation rather than plant competition for maximum crop yields (Sullivan, 2001). In Ghana, apart from interplanting of field crops, farmers do also intercrop vegetables (Norman, 1992). Cucumber and okra are among the most important vegetables that farmers grow in Ghana, which are commonly interplanted (Norman, 1973). Despite the fact that intercropping of cucumber and okra is a common practice in Ghana studies have not been conducted to find the effect of intercropping on the growth and yield of the crops. The present study was therefore carried out to determine the performance of cucumber and okra in an intercrop system.

MATERIALS AND METHODS

The experiment was conducted at the University of Ghana Farm, Legon in 2004 and 2005. Cucumber (*Cucumis sativa* var Poinsett) and okra (*Abelmoschus esculentus* var Legon Spineless) were used in the study. Cucumber was planted, two per hole at a spacing of 90 cm x 90 cm and later thinned to one plant per stand. Okra was also planted, two per hole, but at two spacing of 80 cm x 40 cm – 1-row and 80 cm x 20 cm – 2-row between two rows of cucumber and later thinned to one per stand. The following treatments were used: sole cucumber; sole okra; one rows of okra (at 80 cm x 40 cm) between 2 rows of cucumber and two rows of okra (at 80 cm x 20 cm) between 2 rows of cucumber. The treatments were replicated four times in a randomized complete block design (RCBD). Cucumber plants were not staked but were prevented from climbing the okra plants. N-P-K (15: 15: 15) and sulfate of ammonia fertilizers were applied at 200 and 125 kg ha^{-1} at the 4th and 8th week, respectively after planting by side dressing. Ten plants for each crop were used as record plants and the following data were recorded: weekly plant height and vine length for okra and cucumber, respectively number of days to flowering for okra; number of days to the appearance of male and female flowers in cucumber; fruit length and fruit diameter; percentage fruit set, yield/plant, yield/ha and weed re-infestation.

RESULTS AND DISCUSSION

Table I shows the effect of the various cropping patterns on the plant height of okra. The height of okra plants increased under intercropping. However, early in the season there was no significant difference in height among the treatments. Later in the season plants under intercrop had a significant increase in height, which may be due to the fact that since cucumber matures rapidly and with time competition for resources was reduced and the okra took

Table I. The effect of intercropping cucumber and okra on the height (cm) of okra

Treatment	Weeks after planting								
	2	3	4	5	6	7	8	9	10
Sole Okra	5.2a	14.2a	18.3a	24.7a	31.7a	34.7a	34.7a	39.2a	41.2a
Cucumber + 1- row Okra	6.9a	6.9a	25.9a	31.9a	42.5a	45.0a	48.0b	50.4ab	51.1a
Cucumber + 2 - rows Okra	6.4a	6.4a	21.9a	21.9a	39.5a	45.5a	48.5b	52.2b	54.9a
LSD (P<0.05)	NS	NS	NS	NS	NS	NS	11.5	11.6	NS

Means within a column followed by the same letter are not significantly different

Table II. The effect of intercropping cucumber and okra on number of days to flower for cucumber

Treatment	Cucumber		Okra
	Days to the appearance of male flowers	Days to the appearance of female flowers	Days to flowering
Sole Cucumber	30.3a	33.0a	49.5a
Cucumber + 1- row Okra	27.3b	30.3b	48.5a
Cucumber + 2- rows Okra	28.8c	31.8c	49.3a
LSD (P<0.05)	1.3	1.2	NS

Means within a column followed by the same letter are not significantly different

Table III. The effect of intercropping cucumber and okra on the yield of cucumber

Treatment	Percent fruit set (%)	No. of fruits plant^{-1}	Fruit length (cm)	Fruit diameter (cm)	Yield (g plant^{-1})	Yield (tones ha^{-1})
Sole Cucumber	85.5a	17.6a	11.5a	3.0a	476a	10.23a
Cucumber + 1- row Okra	73.2ab	19.0a	14.5b	3.7b	513a	12.66a
Cucumber +2 - rows Okra	68.4b	15.0b	12.1ab	2.9c	437a	10.79a
LSD (P<0.05)	15.1	2.1	2.6	0.6	NS	NS

Means within a column followed by the same letter are not significantly different

Table IV. The effect of intercropping cucumber and okra on the yield of okra

Treatment	Percent fruit set (%)	No. of fruits plant^{-1}	Fruit length (cm)	Fruit diameter (cm)	Yield (g plant^{-1})	Yield (tonnes ha^{-1})
Sole Okra	92.5a	18.0a	5.4a	2.8a	167a	5.22a
Cucumber + 1-row Okra	70.0a	15.0a	8.4a	3.2a	165a	5.17a
Cucumber +2 - rows Okra	40.0b	9.0b	7.9a	2.8a	89b	5.56a
LSD (P<0.05)	26.9	7.9	NS	NS	76.1	NS

Means within a column followed by the same letter are not significantly different

Table V. Effect of intercropping cucumber and okra on the presence of weeds

Type of Weed	Cucumber		Okra		Cucumber + 1 Row Okra		Cucumber + 2 Rows Okra	
	Wk 4	Wk 7	Wk 4	Wk 7	Wk 4	Wk 7	Wk 4	Wk 7
Cyperus rotundus	P	P	P	P	P	P	P	P
Senna ubtusifolia	P	R	P	P	P	A	P	A
Brachiaria lata	P	R	P	P	P	P	P	P
Croton spp	P	P	P	P	P	R	P	A
Digitaria horizantalis	P	P	P	P	P	R	P	A
Trianthema portulacastrum	P	R	P	P	P	A	P	A
Paspalum orbiculare	P	P	P	P	P	R	P	R
Euphorbia leptophylla	P	R	P	P	P	A	P	A
Celosia laxa	P	R	P	P	P	A	P	A
Stachytarpheta cayenensis	P	P	P	P	P	R	P	R
Cleoma viscosa	P	R	P	P	P	R	P	A

Key: P = present; R = reduced in number; A = Absent; Wk = Week

advantage of the remaining resources to grow taller. The physical arrangement of the two plants in an intercrop system has been reported to help conserve soil moisture (Gliessman, 1998). Furthermore, the leaf cover provided by the spreading cucumber under the intercrop system might have also conserved more soil moisture to support the growth of okra (Gilley *et al*., 1997; Theunissen, 1997; Poudel *et al*., 1999; Gilley *et al*., 2002).

The number of days to flowering in cucumber was significantly reduced when intercropped with okra. There was no significant difference in the number of days to flowering in okra for the three treatments (Table II). When okra was planted as a sole crop, it flowered after 49.5 days. The intercrop systems were therefore more beneficial to cucumber in conserving moisture in the soil for rapid development. Percent fruit set increased when cucumber

was interplanted with okra but decreased with greater plant population of okra (Table III). When cucumber was planted as a sole crop, percent fruit set was significantly lower (40%) as compared to intercropping with one (92.5%) and two (70%) of okra. Increased competition for water, nutrients and space with increased plant population of okra may account for the differences in fruit set under the two intercropped systems. Data in Table IV show that percent fruit set in okra also decreased with an increase in plant population under intercropping. Sole crop okra had the significantly highest percentage fruit set of 92.5%, which decreased to 70.0 and 40%, respectively in 1-row and 2-row okra intercrop.

There was significant difference in the number of fruits per plant, which increased with intercropping but decreased with greater plant population. The number of fruits per cucumber plant increased from 17.0 in sole cropped cucumber to 19.0 when intercropped with 1-row of okra but decreased to 15.0 in the 2-row okra. Significant reduction in fruits/okra plant was recorded between sole cropping okra and cucumber +2-row intercrop. No significant difference was noted in the number fruits per okra plant at both levels of okra intercrops although there was a reduction with increased okra population from 1-row to 2-row okra.

The denser canopy on intercropped plots reduced weed population and thus plant competition. In intercrop systems where a main crop was intersown with a 'smother' crop species, weed biomass in the intercrop was lower than in the main crop grown alone (Liebman & Dyck, 1993). Cucumber as a sole crop resulted in fruit yield of 376 g plant^{-1}, while as an intercrop with one and two rows okra it yielded 513 g plant^{-1} and 437 g plant^{-1}, respectively. Fruit length increased in intercropped cucumber but was not significantly affected when plant population was increased (Table III). The length of cucumber fruit significantly increased from 11.5 cm in intercropping to 14.5 cm in intercropped plants. In 2-row okra intercrop the length of cucumber fruits was significantly reduced from 14.5 cm to 12.1 cm. Fruit diameter of cucumber also increased significantly with intercropping but decreased with increased plant population of okra. Number of fruits per plant decreased with increased plant population under intercropping (Table III). The fruits from intercropped plant were longer and bigger than those from the sole crop plants.

When okra was planted as a sole crop the fruit yield per plant (167 g) was not significantly different from that of 1-row intercrop (165 g) however, there was a significant reduction in fruit yield per plant under the 2-row intercrop. The higher plant population under 2-row okra intercrop resulted in the highest yield per hectare (Table IV). Padmavathi and Raghavaiah (2004) reported that yields per plant of vegetable intercrops were greater in monoculture. The additional benefits of weed control, moisture conservation coupled with a reduced competition between the okra under the 1-row intercrop ate the likely factors contributing factors contributing to the results obtained in this study.

The number and types of weeds in the intercropped plots reduced with increased plant population (Table V). Cucumber and okra as sole crops did not show any effective weed control. When cucumber was intercropped with okra, especially with two rows of okra, the canopy became denser and more effective in suppressing weed growth, especially broadleaf weeds. The reduction of weed infestation by intercropping has been reported by a number of researchers (Yin, 1982). One way to assess the benefits of intercropping is to measure productivity using land equivalent ratio (LER) described by Onwueme and Sinha (1991), which compares the yields from growing two or more crops together with yields from growing the same crops as single monocultures or pure stands.

An LER greater than 1.0 usually shows that intercropping is advantageous whereas an LER less than 1.0 shows a yield disadvantage (Gliessman, 1998). Calculated LER for both intercrop situations in this study was greater than 1 and had an advantage over sole cropping of okra. The slightly higher LER for 1-row (2.4) than 2-row (2.2), respectively indicate that the 1-row intercrop was better than the 2-row intercrop.

CONCLUSION

The results suggest that okra can be grown as 1-row intercrop with cucumber without compromising on yield. Furthermore, in such an intercrop system cucumber is able to reduce weed competition.

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