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EVALUATION OF SOME MAIZE CULTIVARS UNDER DIFFERENT INTERCROPPING PATTERNS WITH BASIL.

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ABSTRACT

A field experiment was carried out at Sides Agricultural Research Station in Beni-Suif Governorate during 2015 and 2016 seasons to study the effect of some intercropping patterns for basil by100% + maize (25%, 33% or 50%) and three maize cultivars (S.C. 167, T.W.C. 314 and Giza 2) on growth, yield and yield components of basil and maize. A split-plots design with three replications was used. The main plots were devoted to the previous three maize cultivars, whereas, the sub-plots were allocated to the intercropping patterns of maize cultivars with basil. The main obvious results of this study can be summarized as follows. The results revealed that S.C. 167 maize hybrid gave the highest values for yield and yield components characters, while Giza 2 cultivar gave the lowest values in both season. Under interaction, when maize plant density with basil was increased from 25, 33 up to 50 %, grain yield and components of maize recorded gradually increase, as well as maize grain yield had the same trend. The yield of basil and its components as well as essential oil percentage were significantly affected by the intercropping of maize with it, whereas the decrease was evident when intercropped the S.C. 167 followed by T.W.C. 314 and Giza 2. Maximum values of land equivalent ratio (LER) (1.31) when intercropped G. 2 with basil by 100% basil + 50% maize and relative crowding coefficients (10.83 and 15.66) were observed with G. 2 when intercropped by 25% with 100% basil in both seasons, respectively. The data indicated that maize was the dominate and basil was the dominated in all patterns. The return showed that intercropping maize with basil in most treatments was lower compared to solid maize or solid basil planting. The highest net return were LE 14644 when intercropped G. 2 with basil by 100% basil + 25% maize whereas the different between the highest and lower value was LE 6110 in combined data across two seasons.

Key words: Intercropping patterns, *Zea mays* L., Basil (*Ocimum basilicum*), Competitive ratio, Volatile oil percentage and Net return.

INTRODUCTION

Sweet basil(*Ocimum basilicum* L), it one of the most important medicinal plants that have a special place in traditional medicine its dried leaves are used commonly as a flavoring in many food products Essential oils are a diverse group of natural products that are important sources of aromatic and flavoring chemicals in food, industrial, and pharmaceutical products (Charles and simon.,1990). Gajula *et al.* (2009) noticed that besides serving medical and cultural functions, medicinal plants have also an important economic role across the country. Kwee and Niemeyer (2011) stated that secondary metabolites from *Ocimum* species possess exceptional biological activity and have antioxidant and antimicrobial (Annand *et al.,* 2011), bactericidal (Haniff *et al.,* 2011), repellent (Nerio *et al.*, 2010), anticonvulsant (Freire *et al.,* 2006), chemo preventive and radio protective effects. (Sujatha *et al.,* 2011) Reveled that it should be kept in mind that intercropping has a long history in food production in the World. Medicinal plants are considered as a source of health products, essential oils and other natural aroma chemicals in the national and international markets. Chen *et al*., (2012) reported that intercropping is defined as an environmental friendly method. Now a day, this method has become one of the popular methods in agricultural system due to the more efficient use of resources and its role in reduction in weeds interference and other pests.

On the other hand, there is a little bit information on intercropping of these plants. Therefore, the objectives of this study were to:

1) Determine weed suppression ability of intercropping.
2) Determine yield advantages of intercropping patterns.
3) Study of volatile oil percent and yield of sweet basil intercropped with maize.
4) Increasing the income for the farmer.

Intercropping is one of the most common practices used in sustainable agricultural systems which have an important role in increasing the productivity and stability of yield in order to improve resource utilization and environmental factors. Rajeswara Rao (2002) whereas noted that the intercropping of maize mint (*Mentha arvensis* L. *Piper ascens* Malinv.) with rose-scented geranium (*Pelargonium* sp.) decreased the essential oil of mint by 59.1% due to reduction in biomass yield compared to monoculture of maize mint. In addition, differences in total essential oil yield of rose-scented geranium were not significant in sole and intercropping systems, because biomass yield of these cropping systems did not have significant variations. Maffei and Mucciarelli (2003) Intercropping peppermint with soybean resulted in yield and quality increases in the essential oil, compared to sole peppermint cultivation.

The yield was higher by about 50% on an equal land area basis and higher percentages of menthol and lower percentages of month of urn and methyl acetate improved the quality of the oil. The aim of this research to investigate the changes in yield and yield components of sweet basil cultivars affected by different intercropping patterns with maize. Lamlom (2006) indicated that intercropping patterns significantly reduced all growth characters, yield and components of soybean and maize cultivars as well as oil percentage of soybean. Nofal and Attalla (2006) reported that under different intercropping systems of some maize hybrids with peanut, there was a significant difference among the efficiency of hybrid maize for growth, yield and yield components of both crops (Yilmaz *et al.*, 2007).

Intercropping indices were calculated by means of land equivalent ratio (LER), aggressively (A), crowding ratio (CR), and actual yield loss (AYL). Competition indices revealed that both the common vetch-barley and the Hungarian vetch-barley intercropping are at a seeding ratio of 80%:20%, respectively, were advantageous due to their high yield, land use efficiency, and economic value compared to other mixtures or pure stands. Gaballah *et al.* (2008) found that the highest yield as units of cereal was obtained under 1:2 soybean/maize intercropping pattern and irrigation using 1.2 evaporation pan coefficient compared with either sole maize or sole soybean planting. Morgado and Willey (2008) showed that the significant decrease in branch number, biological yield and herbal yield of basil with increasing basil population in intercrop might also due to increment in competition for soil resources. Abou Keriasha *et al.* (2009) found that the yields of maize, cowpea or bean under intercropping were lower than the total yield of its respective pure stand.

The yield reduction of intercropped maize ranged from 10- 15 % as compared with pure stand. Mirhashemi *et al.* (2009) also reported that essential oil yield of ajwain (*Carum copticum*) intercropped with fenugreek (*Trigonella foenum-graecum*) was lower than sole crop of ajowan. Abou Keriasha *et al.* (2010) also showed that maize grain yield was dominant while intercropped crops were dominated, where the highest land equivalent ratio (LER) recoded 1.15 and monetary LE 776.96 when maize intercropped with soybean.

Indicated that the more efficient exploitation of resources in intercropping happens because the component crops use the resources either at different times or obtain resources from different parts of soil or aerial environment. Aminifard *et al.*(2012) The results showed that vegetative growth characteristics (plant height, lateral stem number and leaf dry matter) and reproductive factors (fruit volume, fruit weight and plant yield) decreased with increasing plant density, but total yield (kg/ha) increased with increasing plant density. The highest and lowest total yields were obtained by plant density 20×50 cm and 30×100 cm respectively. (Bagheri *et al.*, 2014) showed the results indicated that intercropping increased yield and volatile oil percentage of sweet basil.

Thus, intercropping improved use efficiency of growth resources. Among intercropped treatments, intercropping of maize with sweet basil was more successful than intercrop with borage. In general, intercropping of 50:50, maize sweet basil could be proposed as an efficient system. Hamd Alla *et al*.(2014) Results indicated that intercropped maize plants with cow pea, exhibited greater potentiality and resulted in higher values of most of the studied criteria viz., plant height, number of ears/plant, number of rows/ear, number of grains/row, grains weight/ear, 100–grain weight and straw and grain yields. Fresh and dry forage yields of cowpea were lower in intercropping with maize than sole. Lamlom and Ewis (2015) indicated that all intercropping patterns reduced all growth characteristics and yield of both crops compared with solid planting. The yield and yield components of both crops were significantly affected by different intercropping patterns. Hamed *et al*. (2016) showed that number of branches and grains per plant, grain and biological yield in both sweet basil Mubarak and Italian large leaf cultivars were decreased with increasing this plants density in intercropping with corn.

Therefore, the aim of this study increasing the cultivated area of the maize to be loaded with basil without disturbing the crop composition.

MATERIALS AND METHODS

A field experiments were carried out at Sides Agric. Res. station, Egypt in 2015-2016 seasons to study the differences among three maize cultivars (S.C. 167, T.W.C. 314 and Giza 2) and the effect of intercropping systems, beside of four solid stands (three maize cultivars and basil pure stand) on growth, yield and yield components of maize and Basil. A split-plots design with three replications was used. The main plots were devoted to the previous three maize cultivars, whereas, the sub-plots were allocated the intercropping patterns of maize cultivars with basil. The size of sub-plots was 25.2 m^2 (3.0 m long, containing 12 ridges at ridge spacing of 70 cm apart).

Intercropping patterns:-

In all intercropping patterns or solid planting, basil planted two rows of the ridge and the distance between the plant and the other 25 cm apart and thinned to one plant/ hill.

Solid planting (control):-

Pure maize was grown in ridges of 70 cm apart, in hills spaced 25 cm, one plant per hill giving 24000 plant/ fad, while pure basil was grown two side of the ridge at 25 cm apart with one plant/ hill giving 48000 plant/ fad).

Intercropping Patterns:-

In all intercropping patterns or solid planting, Basil planted two rows of the ridge (the first row was planted on the side of ridge and the second row was planted on the top of the ridge) and the distance between the plant and the other 25 cm apart and thinned to one plant/hill and planting maize on the other side of the ridge according to intercropping patterns.

Basil species was sown by seeds in April 25th and May 1st in the first and second season respectively, while maize was sowing on May 30th and Jun. 4th in the first and second season, respectively. During land preparation 45 kg P_2 O_5/fad in the form of calcium super phosphate (15% P_2O_5) were added. Nitrogen fertilizer was used at the rate of 120 kg N/ fad for basil and maize according to plant density per unit area in the forum of (Ammonium sulphate 20.5% N) in four equal doses, the first dose was after thinning and the second done after the first cutting (70 days from planting) and this is repeated after each cat. Potassium fertilizer was added at a rate of 72 kg K /fad in the forum of (Potassium sulphate 48% K) in three equal doses, Normal cultural practices for growing both crops were followed as recommended. First, second and third cutting was carried out on July 5th, August 5th and September 7th in the first season. Whereas, it was carried out on July 10th, August 10th and September 10th in the second season for basil. Harvesting took place on September 25th and 30th for maize, in the first and second season, respectively.

At harvesting, crop of experimental plot were taken at random from each treatment in each replicate to estimate growth characters and yield components, while fresh yield of basil and grain yield of maize were estimated on plot basis and transformed to thereafter ardb/fad. Dried leaves of basil were ground into very fine powder to estimate oil percentage using the modified the oil extraction method using water distillation as mentioned in the and connected to the flask (Clevenger) was used as Clevenger apparatus. Guenther (1961).

Studied characters:

At harvest, experimental plot were taken at randomly to determine yield and yield components of basil and maize (grain yield ardb/fad., at 15.5% moisture (ardb = 140 Kg).

A– Maize characteristics: Plant height (cm), ear height (cm), ear length (cm), ear, diameter (cm) number of rows/ear, number of grains/row, 100 – grain weight (g): estimated as the average of ten plants.

B– Basil characteristics: Ten plants were taken at random for each sup plot and the following characteristics were recorded plant height (cm), number of branches, estimated as the average of ten plants, fresh and dry weights of herb/ plot (kg), fresh and dry weights of herb/ fad, (ton) and essential oil percentage.

C- Competition parameters: In order to assess the nature and degree of competition between maize and basil_plants, the following parameters were determined:

1)Land Equivalent Ratio (LER.):-

LER is determined as the sum of the fractions of the yield of the intercrops relative to their sole crop yields according to Andrews and Kassam (1976), the following formula:

$$LER = Y_{bm} / Y_{bb} + Y_{mb} / Y_{mm}$$

Where, Y_{bb} = Pure stand yield of basil, Y_{mm}= Pure stand yield of maize., Y_{bm}= Mixture yield of basil (b) when combined with maize (m), Y_{mb} = Mixture yield of maize when combined with basil.

2) Relative crowding coefficient (K.):-

This was proposed by De-wit (1960). It assumes that mixture treatment from m replacement series. Each series has its own coefficient (K.) which gives m measure of whether that species has produced more or less yield that expected, for species in (m) mixture with species (b) it can be calculated:

$$K_{mb} = Y_{mb} / (Y_{mm} - Y_{mb}) \text{ X } Z_{bm}/Z_{mb}$$

Fore species (b) in m mixture with species (m) it can be similarly calculated:

$$K_{bm} = Y_{bm} / (Y_{bb} - Y_{bm}) \text{ X } Z_{mb} / Z_{bm}, \quad K = kmb \text{ X } k_{bm}$$

These symbol, Y_{mm}= pure stand yield of species m., Y_{bb} = pure stand yield of species b, Y_{mb} = mixture yield of species m (in combination with b).b_m = mixture yield of species b (in combination with m), Z_{mb} = Sown proportion of species m (in mixture with b), Z_{bm} = Sown proportion of species b (in mixture with m).

3-Aggressivity (A):

This parameter was proposed by Mc Gilchrist (1965). Aggressively "A" is determined according to the following formula:

$$A_{mb} = Y_{mb}/Y_{mm} \text{ x } Z_{mb} - Y_{bm}/ Y_{bb} \text{ x } Z_{bm}$$

D. Farmer's benefit: Total cost and net return of each intercropping pattern as compared to recommended sole planting of basil were determined.

1. Total return of intercropping pattern = Price of basil yield + price of maize yield (Egyptian pound), to calculate the total return, the average of basil and maize prices presented according to the Bulletin of the Agricultural Statistics (2016).
2. Net return per faddan = Total return – (fixed cost of basil + variable costs of maize according to intercropping pattern).
3. The average of prices of main products is L.E. 800, 322 for ton of basil, and ardab of maize respectively in 2015 and 2016 seasons.
4. Total costs L.E./Fadden 4187 and 5268 for solid basil and maize, respectively.
5. Total costs of intercropped maize with basil = Total costs of basil + costs of maize.
6. Costs of intercrop maize: 524, 966 and 1048 L.E./ fad., for 25, 33 and 50%, respectively.

Statistical analysis:

The collected data were statistically analyzed according to Sendecor and Cochran (1980) and treatment means were compared by the least significant difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

1- *Effect of maize cultivars on maize characters:*

The effect of maize cultivars on some growth characters, yield and its components of maize was shown in Table (1) data indicated that maize cultivars (S.C. 167, T.W.C. 314 and G. 2) had a significant affect for all characters under study (plant height, ear height, ear length, ear diameter, No. of grains/row, weights of 100- grain and yield/ fad.) in the two seasons except no. of rows/ear it was significant in the first season only. S.C.167 cultivar recorded the highest values in most characters except ear diameter and no. of rows/ ear whereas G. 2 recorded the highest values in the last characters while the last cultivar (G. 2) gives the lowest value for all characters except no. of rows/ear whereas T.W.C. 314 gives the lowest value in this two characters in both seasons. The increment in this character for S.C. 167 was due to its superiority for most yield components. Grain yield of S.C. 167 that of the other two cultivars by 4.35%, 19.21%, 7.10% and 20.53% compared with G. 2 in the first and second season, respectively. The differences among cultivars may be due to the difference of genetic constitution of cultivars. This result is in agreement with those reported by Hamd Alla *et al*. (2014) and Lamlom and Ewis (2015).

2-Effect of intercropping patterns

Data in Table (2) showed that intercropping patterns significantly affected all characters of maize. Planting maize on the second basil ridges (100 % basil + 25% maize) recorded the highest values in all characters for maize plants except plant height followed by (100% basil + 33% maize) in both seasons.

While the lowest values was showed with (100% basil + 50% maize). Increasing of intercropped maize ratio with basil gradually increased plant height. This finding may be due to inter-competition between maize plants for light. Yield and yield components of maize were significantly affected by intercropping patterns in 2015 and 2016 seasons. Ear length, ear diameter, number of rows/ ear, number of grains/row and weight of 100-grains decreased with increasing maize/ basil ratio of intercropping patterns. Concerning grain yield it was noticed that intercropping decreased gain yield as compared with sole cropping.

Pure stand of maize had the highest grain yield. Since grain yield was obtained from the whole land area compared with intercropping treatments, which were obtained from 25%, 33% and 50% in intercropping patterns, respectively. Intercropping patterns (100% basil + 25% maize) and (100% basil + 33% maize) gave the highest value of grain yield there were no significant differences between them. Whereas, intercropping patterns 100 % basil + 25% of maize from pure stand gave the lowest values of grain yield/ fad in the two seasons. The reduction in grain yield/fad under intercropping patterns as compared with solid planting may be due to variation of plant density for both crops per unit area under intercropping systems, which resulting in maximizing the effect of inter and intra-specific competition among maize plants, also of inter specific compacts finger between basil and maize plants. Similar results were obtained by Abou Keriasha *et al.* (2010) and Echarte *et al.* (2011).

3-Intercation effects between maize cultivars and intercropping patterns:

Data presented in Tables (3 and 4) indicated that plant height, ear height, ear length, ear diameter, number of rows/ear, number of grains/ row weight of 100-grain and grain yield/fed were significantly affected by the interaction between maize cultivars and intercropping patterns in both season. Results show that intercropping pattern of (100 % basil + 25% maize) recorded the highest value for of S.C.167 maize cultivar and all characters of maize except ear diameter and No. of rows/ear. On the other side, the lowest value was showed with G. 2 under 100 % basil + 50 % maize pattern in both seasons, whereas the intercropping pattern of (100 %

basil + 50% maize) recorded the lowest values for the ear diameter and number of rows/ear in both seasons with T.W.C. 314 cultivar. For grain yield, results indicated that S.C. 167 recorded the highest values when maize was planted on the other side of the second basil ridge; and on the opposite, Giza 2 gave the lowest value when maize was planted on the other side of fourth basil ridge for grain yield /fad in both seasons. Similar results were obtained by Gaballah *et al*. (2008) and Abou Keriasha *et al*. (2009).

Data as shown in Tables (3 & 4) compared with sole basil data. The maximum reduction was showed with G. 2 cultivar followed by S.C. 167; and the minimum values were showed with T.W.C. 314 cultivar. This reduction indicates clearly that the great competition resulting from maize plants through their shading effect, as well as the effect of competition among basil and maize plants.

4- Effect of cultivars for maize on basil:-

The characteristics of basil (plant length, number of branches, fresh herb weight per plant and fad.) were significantly influenced by different maize cultivars intercropped with it in both seasons, Table 5. Whereas the highest values of these qualities when intercropping G. 2 with basil and gave the lowest values when intercropping T.W.C. 314 with the basil except the attribute of the height of the plant whereas gave the lowest values when intercropping the S.C. 167 with basil. The second and third cuts were more significantly when intercropping different maize cultivars compared with the first cut this may be due to the first cut was taken before the full growth of maize as well as the second cut was also more affected than the third cut.

This may be due to the different morphological composition of each maize cultivar in terms of plant height, number of leaves, leaf area index and the angle of the leaf for each cultivar. The fresh and dry yield of the basil was significantly higher when intercropped with of G .2, compared with S.C.167 and T.W.C. 314, respectively. The highest ratio of fresh yield was 17.71 and 21.01% in the first season, while it was 16.16 and 25.29% in the second season as well as the highest ratio of dry yield was 13.02% and 24.84% in the first season, while it was 18.49% and 30.61% in the second season compared to the S.C.167 and T.W.C. 314, respectively. Similar results were reported by Lamlom and Ewis (2015) and Aminifard *et al*. (2012).The characteristics of basil were adversely affected by intercropping maize with basil Compared to pure stung as well as it affected by intercropping patterns.

Table (5): Basil plant height and branch number per plant at different cuttings as influenced by intercropping patterns, cultivars and their interaction.

Cultivar (V)	Intercropping patterns (I)		Plant height (cm)				Branch			
			Cutting number							
			I	II	III	Mean	I	II	III	Mean
(2015)										
S.C.167	+ Maize %	25	66.33	54.12	63.17	61.21	6.33	5.67	6.67	6.22
		33	66.16	50.33	61.12	59.20	5.85	3.67	5.18	4.90
		50	69.13	43.15	56.33	56.20	5.36	1.67	3.00	3.34
Mean			67.21	49.20	60.21	58.87	5.8	3.67	4.95	4.82
T.W.C. 314	+ Maize %	25	65.51	53.31	61.31	60.04	5.33	5.33	6.55	5.74
		33	68.12	48.16	58.15	58.14	4.67	3.55	4.85	4.36
		50	69.33	43.12	56.12	56.19	4.23	1.67	3.33	3.08
Mean			67.65	48.20	58.53	58.12	4.7	3.52	4.91	4.39
G. 2	+ Maize %	25	65.13	61.13	70.33	65.53	7.23	6.67	6.33	6.74
		33	68.31	58.12	66.20	64.21	6.67	5.33	5.33	5.45
		50	68.16	52.15	63.51	61.27	6.00	4.30	4.67	4.32
Mean			67.20	57.13	66.68	63.67	6.6	5.43	5.78	5.61
Mean of Intercropp	+ Maize %	25	65.66	56.19	64.94	62.26	6.30	5.89	6.52	6.24
		33	67.53	52.20	61.82	60.52	5.73	4.18	5.12	4.90
		50	68.87	46.14	58.65	57.89	5.20	2.55	3.67	3.58
LSD at 0.05	Cultivar		N.S	2.95	N.S	3.12	N.S	0.28	0.77	0.55
	Intercropping		N.S	1.68	1.68	2.09	N.S	0.33	0.27	0.38
	Interaction		N.S	4.57	4.81	4.66	N.S	0.37	1.10	0.89
Pure Basil			68.51	70.33	70.33	69.72	6.6	7.33	6.67	6.89
(2016)										
S.C.167	+ Maize %	25	58.33	48.15	62.31	56.26	6.67	5.00	5.67	5.78
		33	66.12	43.33	55.15	54.87	5.00	3.23	4.00	4.08
		50	66.31	43.33	52.33	53.99	4.00	1.67	2.67	2.78
Mean			63.59	44.94	56.60	55.04	5.22	3.30	4.11	4.21
T.W.C. 314	+ Maize %	25	65.11	53.33	65.33	61.26	5.00	5.00	4.67	4.89
		33	66.12	42.51	59.11	55.91	4.00	3.13	3.67	3.57
		50	67.15	39.11	53.33	53.20	3.85	1.55	3.00	2.8
Mean			66.13	44.98	59.26	55.68	4.33	3.23	3.78	3.78
G. 2	+ Maize %	25	61.67	63.33	65.15	63.38	7.33	6.67	7.33	7.11
		33	62.14	61.49	69.51	60.33	6.00	5.67	5.33	5.33
		50	65.33	58.12	52.15	58.53	5.33	3.33	4.67	4.00
Mean			63.05	60.98	59.81	61.28	6.33	5.22	5.78	5.52
Mean of Intercropping	+ Maize %	25	61.70	53.94	63.26	59.63	6.33	5.56	5.89	5.93
		33	64.79	48.11	57.80	56.90	5.00	4.01	4.33	4.34
		50	66.26	45.85	51.60	54.57	4.39	2.18	3.45	3.19
LSD at 0.05	Cultivar		N.S	3.04	2.99	2.78	N.S	0.53	0.39	0.56
	Intercropping		N.S	1.55	1.37	1.54	N.S	0.39	0.27	0.42
	Interaction		N.S	4.93	4.50	5.17	N.S	0.78	0.71	0.81
Pure Basil			65.33	68.13	67.11	66.86	6.33	6.33	6.00	6.22

The highest values of fresh and dry yield/ fad., observed in intercropping pattern (100% basil +25% maize) followed by 100% basil +33% maize, and 100% basil +50% maize, which gave the lowest values and the decreasing rate was 15.62, 19.37 and 40.32% in the first season and15.09, 24.29 and 43.89% compared with the sole planting for basil in the second season respectively. This decreasing is due to the difference in the plant density of the intercropped maize.

Data in Tables (6 & 7) revealed that the effect of interaction between maize cultivars and intercropping system was significant for plant height, number of branches/plant, fresh yield/ plant and fed., dry yield/plant and fad. Results showed that intercropping G. 2 maize cultivar on the other side of the fourth basil ridges gave the highest values and simultaneously, T.W.C. 314 maize hybrid when intercropped on the other side of the second basil ridge gave the lowest value. This is completely true for yield and its components in both seasons.

7- Volatile oil of sweet basil leaves:-

Data in Table (8) showed that the highest amount of sweet basil oil (0.225 & 0.210%) in the first and second seasons was achieved when basil intercropped with in G. 2 cultivar compared with the others maize cultivars (S.C.167 and T.W.C. 314) for. The volatile oil of intercropped sweet basil was lowest than sole sweet basil in the first and second season. Whereas the decreasing rate was 27.91, 32.89 and 25.25% in the first season while it was 30.21, 33.68 and 27.08% in the second season compared with the sole planting. This is suggesting that, the competition of maize with sweet basil plants for light resulted in the reduction in volatile oil percentage. These results are consistent with Maffei and Mucciarelli (2003) and Mirhashemi *et al.* (2009).

Competitive relationships:-

1-Land equivalent ratio (LER):-

The relative yield of maize was appreciably influenced by the interaction effect of maize cultivars and intercropping patterns (Table 9). While the trend of changes in Lm values of maize behaved in dependently within each pattern. Highest values for Lm of maize were obtained for T.W.C. 314 when intercropped with basil in (100 % basil + 50% maize) pattern (0.59 and 0.64) in the first and second season.

While, Ry values of basil obtained higher values when Giza-2intercropped with basil under (100% basil + 25% maize) pattern 0.96 and 0.97 in the first and second season. Values of land equivalent ratios revealed that intercropping resulted in more yield advantages in all intercrop combinations with the three tested maize cultivars given higher values of land equivalent ratio. The highest (LER) values were associated with Giza-2

Table (6): Fresh wt. of herb per plant and fad. of basil at different cuttings as influenced by intercropping systems, cultivars and their interaction.

Maize cultivars (V)	Intercropping patterns (Basil 100%)		Fresh wt. of herb/plant (g)				Fresh wt. of herb/fed. (ton)			
			Cutting number							
			I	II	III	Total	I	II	III	Total
(2015)										
S.C.67	+ Maize %	25%	153.8	104.1	140.5	398.4	7.382	4.997	6.744	19.123
		33%	145.3	83.22	128.9	357.4	6.974	3.995	6.187	17.156
		50%	109.8	55.30	105.6	270.7	5.270	2.654	5.069	12.993
Mean			**136.3**	**80.87**	**125.0**	**342.2**	**6.542**	**3.882**	**6.000**	**16.424**
T.W.C.314	+ Maize %	25%	150.5	91.25	133.7	375.5	7.224	4.380	6.418	18.022
		33%	148.2	87.50	129.9	365.6	7.114	4.200	6.235	17.549
		50%	102.1	43.25	98.72	244.1	4.901	2.076	4.739	11.716
Mean			**133.6**	**74.01**	**120.8**	**328.3**	**6.413**	**3.552**	**5.797**	**15.762**
G. 2	+ Maize %	25%	168.6	150.3	142.5	461.4	8.093	7.214	6.840	22.147
		33%	157.8	142.5	139.6	439.9	7.574	6.840	6.701	21.115
		50%	121.1	109.5	115.4	346.0	5.813	5.256	5.539	16.608
Mean			**149.2**	**134.1**	**132.5**	**415.8**	**7.160**	**6.437**	**6.360**	**19.957**
Mean of Intercrop ping	+ Maize %	25%	157.6	115.2	138.9	411.7	7.566	5.530	6.234	19.764
		33%	150.4	104.4	170.7	425.5	7.221	5.012	6.374	18.607
		50%	111.0	69.35	106.6	286.9	5.328	3.329	5.116	13.773
L.S.D at 0.05	Cultivars		**N.S**	**8.12**	**7.45**	**9.41**	**N.S**	**0.475**	**0.390**	**0.444**
	Intercropping		**N.S**	**7.11**	**6.33**	**8.11**	**N.S**	**0.361**	**0.313**	**0.412**
	Interaction		**N.S**	**16.6**	**14.00**	**15.33**	**N.S**	**0.833**	**0.711**	**0.8.231**
Pure Basil			**210.7**	**185.5**	**132.8**	**529**	**8.692**	**7.533**	**6.852**	**23.077**
(2016)										
S.C.167	+ Maize %	25%	137.3	98.67	128.3	364.3	6.590	4.736	6.158	17.48
		33%	129.1	79.20	117.5	325.8	6.197	3.802	5.640	15.64
		50%	101.2	50.81	89.70	241.7	4.858	2.439	4.306	11.60
Mean			**122.5**	**76.23**	**111.8**	**310.5**	**5.882**	**3.659**	**5.368**	**14.91**
T.W.C. 314	+ Maize %	25%	126.3	82.67	123.9	332.9	6.062	3.968	5.947	15.98
		33%	117.5	66.22	102.5	286.2	5.640	3.179	4.920	13.74
		50%	93.22	40.73	77.15	211.1	4.475	1.955	3.703	10.13
Mean			**112.3**	**63.21**	**101.2**	**276.7**	**5.392**	**3.034**	**4.857**	**13.28**
G. 2	+ Maize %	25%	153.1	130.5	145.1	428.7	7.349	6.264	6.965	20.58
		33%	140.7	129.2	121.6	391.5	6.754	6.202	5.837	18.79
		50%	109.8	81.50	99.65	290.9	5.270	3.912	4.783	13.97
Mean			134.5	113.7	122.1	370.3	6.458	5.459	5.862	17.78
Mean of Intercropping	+ Maize %	25%	138.9	103.9	132.4	375.2	6.667	4.989	6.357	18.01
		33%	129.1	91.54	113.9	334.5	6.197	4.394	5.466	16.06
		50%	101.4	57.68	88.83	247.9	4.868	2.769	4.264	11.90
LS.D at 0.05%	Cultivars		N.S	11.9	10.6	11.18	N.S	0.602	0.494	0.555
	Intercropping		N.S	10.2	8.95	9.56	N.S	0.451	0.412	0.451
	Interaction		N.S	21.7	20.1	30.21	N.S	1.168	0.899	0.996
Pure Basil			199.5	171.8	155.1	526.4	8.177	6.903	6.135	21.21

Table (7). Dry weight of herb per plant and fad., of basil at different cuttings as influenced by intercropping systems, cultivars and their interaction.

Maize cultivars	Intercropping Patterns (Basil 100%)		Dry wt. of herb/ plant (g)				Dry wt. of herb/ fad. (ton)			
			Cutting number							
			I	II	III	Total	I	II	III	Tot
(2015)										
S .C.167	+ Maize %	25	13.98	8.72	12.54	35.24	0.671	0.419	0.602	1.69
		33	12.52	6.33	10.89	29.74	0.601	0.304	0.523	1.42
		50	10.39	3.24	8.37	22.00	0.499	0.156	0.402	1.05
Mean			12.30	6.10	10.60	29.00	0.590	0.293	0.509	1.392
T.W.C. 314	+ Maize %	25	11.30	7.33	11.14	29.77	0.542	0.352	0.535	1.42
		33	10.83	4.76	10.11	25.70	0.520	0.229	0.485	1.23
		50	9.22	3.11	7.37	19.70	0.443	0.149	0.354	0.94
Mean			10.45	5.07	9.54	25.06	0.502	0.243	0.458	1.203
G. 2	+ Maize %	25	14.15	11.82	12.54	38.51	0.679	0.567	0.602	1.84
		33	13.78	11.59	11.66	37.03	0.662	0.556	0.560	1.77
		50	11.80	7.68	9.13	28.61	0.566	0.369	0.438	1.37
Mean			13.24	10.36	11.11	31.29	0.636	0.497	0.533	1.666
Mean of Intercrop. ping	+ Maize %	25	13.14	9.29	12.07	34.50	0.631	0.446	0.579	1.65
		33	12.38	7.56	10.89	30.83	0.594	0.363	0.523	1.48
		50	10.47	4.68	8.29	23.44	0.503	0.225	0.398	1.12
L.S.D at 0.05	Cultivars		N.S	3.68	3.22	4.06	N.S	0.073	0.167	0.12
	Intercropping		N.S	2.82	2.45	2.75	N.S	0.109	0.133	0.15
	Interaction		N.S	6.55	5.90	6.13	N.S	0.321	0.268	0.33
Pure Basil			15.83	13.99	12.22	42.04	0.735	0.616	0.637	1.988
(2016)										
S.C. 167	+ Maize %	25	12.13	7.57	11.94	31.64	0.582	0.363	0.573	1.51
		33	11.91	5.91	10.76	28.58	0.572	0.284	0.517	1.37
		50	10.72	3.39	7.87	21.98	0.515	0.163	0.378	1.05
Mean			11.59	5.62	10.19	27.4	0.556	0.270	0.489	1.315
T.W.C. 314	+ Maize %	25	10.33	6.07	10.78	27.18	0.496	0.291	0.517	1.30
		33	10.06	4.63	9.26	23.95	0483	0.222	0.445	1.15
		50	8.93	3.28	6.66	18.87	0.429	0.157	0.320	0.90
Mean			9.77	4.66	8.90	23.33	0.469	0.224	0.427	1.120
G. 2	+ Maize %	25	14.11	11.54	12.72	38.37	0.677	0.554	0.611	1.84
		33	13.07	11.21	11.37	35.65	0.627	0.538	0.546	1.71
		50	11.39	6.33	9.13	26.85	0.547	0.304	0.438	1.28
Mean			12.86	9.69	11.07	33.62	0.617	0.465	0.531	1.613
Mean of Intercrop.	+ Maize %	25	12.19	8.39	11.81	32.39	0.585	0.403	0.567	1.55
		33	11.68	7.25	10.46	29.39	0.560	0.348	0.502	1.41
		50	10.46	4.33	7.88	22.67	0.502	0.208	0.378	1.08
L.S.D at 0.05	Cultivars		N.S	4.99	3.68	4.89	N.S	0.168	0.149	0.15
	Intercropping		N.S	2.82	2.79	3.24	N.S	0.127	0.115	0.11
	Interaction		N.S	8.15	7.33	8.19	N.S	0.299	0.273	0.31
Pure Basil			15.27	13.33	10.35	38.95	0.705	0.585	0.633	1.923

when intercropped with basil in (100 % basil + 33% maize) pattern (1.31) in both seasons respectively. On the other hand, the lowest land usage was 1.08 and 1.06 which showed with TWC 314 when it was planted on the other side at the fourth ridge of basil (100 % basil + 25% maize) pattern.

2- Relative crowding coefficient (RCC)

To determine if there is m yield m advantage of mixing the product of the coefficient is formed (by multiplying k_{mb} X k_{bm}). If K > 1 there is a yield advantage, if K = 1 there is no difference and if K is < 1 there is a yield disadvantage. Similar results were reported by Abou Keriasha *et al.* (2009 and 2010).

Data presented in Table (9) revealed that Crowding Coefficient had higher than the unit advantage in all intercropping patterns in both seasons. The highest RCC values were achieved by the intercropping trait including 100 % basil + 25% maize when maize plant (cultivar Giza 2) recorded the highest value for (RCC) (10.83 and 15.66) in the first and second season, whereas the lowest value for (RCC) was recorded when maize cultivar (T.W.C. 314) planting by intercropping pattern of (100 % basil + 50% maize) (1.42) in the first season, and (1.32) with intercropping pattern of (100 % basil + 33% maize) in the second season. A yield advantage occurred because the component crops differ in their utilization of growth resources when grown in association and were able to complement each other and became able to maximize over all use of macro and micro environmental resources than when grown separately. If m species has coefficient less than, equal to, greater than one it means it has produced less yield the same yield, or more yield than expected respectively. The component crop with the higher coefficient is the dominant one.

3- *Aggressively (Age):*

Aggressively indicated that maize was the dominant component in all treatments, whereas basil was the dominated as shown in Table 9. The present results indicated that maize as the over story intercrop has higher competitive abilities than basil as the under story component in the two seasons. Similar results were reported by Yilmaz *et al*. (2007).

An aggressively value of zero indicates that the component species are equally competitive for any other situation, both species will have the same numerical value but the sign of the dominant species will be positive and the dominated negative. The greater the numerical value the bigger the difference in competitive abilities and the bigger the difference between actual and "expected" yield.

D. Farmer's benefit

Intercropping maize with basil increased total and net return when intercropped cultivar G. 2 of maize with basil by the intercropping trait including 100 % basil + 25% maize by about 12.52 and 7.92% respectively, as compared with recommended basil, in the combined data across 2015 and 2016 seasons (Table10). Net return of intercropping cultivar G-2 with basil by (100% basil + 25% maize) or (100% basil + 33% maize) reached to L.E. / fad. 14644 and 13953 respectively, as compared with recommended sole basil (L.E. per fed. 13570). The study suggests that growing one row of G. 2 on the third and fourth ridges of basil (60 cm) is more profitable to farmers than recommended sole basil. These results are in harmony with those obtained by (Bagheri *et al.,* 2014).

In conclusion

Finally, intercropping cultivar G. 2 with basil by (100% basil + 25% maize) gave the highest economic net return compared to sole planting for basil.

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تقييم بعض أصناف الذرة الشامية تحت نظم تحميل مختلفة مع الريحان

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اقيمت تجربة حقلية في محطة البحوث الزراعية بسدس محافظة بنى سويف خلال موسمي 2015 و 2016 بهدف تقييم ثلاثة أصناف من الذرة الشامية (هجين فردى 167، هجين ثلاثي 314، جيزة – 2) عند تحميلها مع الريحان (بنسبة 100%) تحت ثلاثة مستويات تحميل من الذرة الشامية (25%، 33% أو 50%) على النمو والمحصول ومكوناته لكل من الذرة والريحان وتم تصميم التجربة بطريقة القطع المنشقة مرة واحدة حيث وضعت أصناف الذرة في القطع الرئيسية ونظم التحميل في القطع الفرعية ويمكن تلخيص النتائج المتحصل عليها في الآتي أظهر الهجين الفردي 167 أعلى القيم في المحصول ومكوناته مقارنة بالهجين الثلاثي 314 وجيزة 2 حيث زاد تدريجيا بزياد كثافة النباتات المحملة من 25 % إلى 50% من الكثافة الكلية في حين تأثر محصول الريحان الطازج والجاف وأيضا نسبة الزيت الأساسي تأثيرا عكسيا سواء بأصناف الذرة أو نظم التحميل المختلفة وكذلك كانت أعلى قيمة لمعدل استغلال الأرض (1,31) عند تحميل صنف الذرة جيزة 2 بكثافة 50% مع 100% ريحان بينما كان أعلى قيمة معامل الحشد النسبي (10,83 ، 15,66) عند تحميل صنف جيزة 2 بكثافة 25% ذرة مع 100% ريحان وكذلك كانت الذرة هي السائدة والريحان هي المسودة في كل معاملات التحميل

كما أظهرت أعلى قيمة لصافى العائد (14644 جنيها) عند تحميل صنف الذرة جيزة 2 بكثافة 25 % مع 100% ريحان حيث كان الفرق بين أعلى قيم وأقل قيمة هو 6110 جنية لقيم متوسط موسمي الدراسة.

التوصية: يوصى بتحميل صنف الذرة جيزة - 2 بنسبة 25% مع الريحان وذلك للحصول على أعلى محصول من عشب الريحان الأخضر والزيت الطيار وأعلى صافى عائد إقتصادى مقارنة بالزراعة المنفردة للريحان.

الكلمات الدالة :- نظم التحميل – الذرة الشامية – الريحان – العلاقات التنافسية – نسبة الزيت الطيار صافى العائد.