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Effect of Nitrogen Fertilizer and Foliar Spraying with Humic Acid on Productivity of Maize, Soybean and Ear Rot Disease of Maize

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ABSTRACT

In the field, two experiments were confirmed in 2017 in addition to 2018 seasons at Sakha Agricultural Researches Station Farm, Agricultural Research Center, Egypt, toward investigate the influence of nitrogen levels (100, 110 and 120 kg N/fed) and spraying with humic-acid levels (without , 2.5, 5.0 and 7.5 g/L) on growth, yield and its attributes, as well ear rot disease of maize under intercropping system of maize and soybean. The field trials were executed in three replicates using split-plot design. The main-plots were consigned to nitrogen levels. The sub-plots were deal out to four levels of humic-acid as foliar spraying. Growth, yield and its attributes of both maize and soybean under intercropping system were significantly improved by rising N-levels from 100 to 110 and 120 kg N/fed and the recommended one was 120 kg N/fed which led to decrease ear rot disease infection and severity. Spraying with humic-acid (7.5 g/L) produced highest growth, yield and its attributes of both maize and soybean under intercropping system and caused more reduction in ear rot disease infection and severity. It can be recommended that the maximum growth, productivity, land equivalent ratio (LER), relative crowding coefficient (RCC), total income (LE), *i.e.*10588.60 and 11032 LE, respectively, economic return (LE) and lowest ear rot disease infection and severity (in maize) under intercropping system of both soybean and maize were obtained from spraying with humic-acid (7.5 g/L) and fertilizing with 120 kg N/fed beneath the environmental circumstances of Kafrelsheikh Governorate, Egypt.

Keywords: Maize, soybean, intercropping, nitrogen levels, humic-acid levels, productivity, ear rot disease.

INTRODUCTION

Intercropping of legumes likes soybean and cereals similar to maize are an old practice in tropical agriculture that leads to maximize use of resources, *i.e.* space, light and nutrients, as well as to increase microbial activity, reduce yield losses by pests and diseases, therefore enhancing crop quality and quantity. Intercropping has been well known as one kind of the sustainable agricultural cropping patterns around the world (Du *et al.* (2018).

Egypt suffer from a large deficit in production of oil, because of low area cultivated with oil crops. This due to low profitability of some oil crops compared with other crops in crop structure. Therefore, Egypt is interest in trying to compensate the gap by increasing cultivated area of oil crops through agricultural systems such as intercropping, which means cultivation of one or more crops such as soybean, sunflower ……. etc as oil crops with the main crops without disordering crop structure.

Nitrogen affects a range of physiological and biochemical procedures in plant cells that eventually affect the plant growth as well as development (Shrestha *et al.*, 2018). Thus, increasing application of N-levels led to significant increases in growth, yield and its components and quality characters of maize crop (Lomer *et al.*, 2019 ; Jiang *et al.*, 2019 and Mahmood *et al.*, 2020). Soybean is considered a legume plant, which has the ability to fix atmospheric nitrogen when properly modulated, and so is less dependent for growth on sources of nitrogen from the soil (Flynn and Idowu, 2015). Rashwan and Zen El- Dein (2017) stated that number of branches per plant, number of pods per plant, seed yield per plant and per fad of soybean as well as total LER and aggressivity were increased with the increment in nitrogen level, especially with application of 120 kg/fed, while the lowest one was obtained with 80 kg/fed. In spite of nitrogen was an important fertilizer of crop production, its excessive application could result in nitrogen loss that could have serious environmental concerns (Gao, *et al.* 2020). Thus, sensible use of nitrogen fertilizer should be promoted on improvement maize and soybean productivity. Cereal–legume intercropping is a sustainable land management practice. This practice contributes to long-term immobilization of nitrogen and controls the currently growing dependence on nitrogenous fertilizers. Additionally, it helps to maintain and improve the soil fertility because leguminous crops like soybean, cowpea and groundnuts accumulate nitrogen from 80 to 350 kg ha^{-1}. These practices not only facilitate the nitrogen uptake but also decrease the nitrogen losses and increase the biomass. Many studies have demonstrated that intercropping not only has obvious advantages on the increase of crop productivity and efficient exploration of agricultural resources (Regehr *et al.*, 2015).

Humic-acid is water-soluble organic acid naturally present in soil organic matter. It can be recognized that humic-acid have many beneficial effects on soil fertility and structure, enhancement in the soil microbial population including beneficial microorganisms, increase in the cation exchange capacity and the pH buffering capacity of the soil and soil microbial populations. In addition, humic-acid compounds may have various biochemical effects either at cell wall, membrane level or in the cytoplasm, including

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increasing photosynthesis and respiration rates in plants, enhanced protein synthesis and plant hormone like activity occupied in plant growth encouragement and uptake of nutrient that increasing yield. Gomaa *et al.* (2014) indicated that usage of humic-acid as foliar spray had a constructive effect on maize growth, grain yield and its components. El-Shafey and Zen El- Dein (2016) demonstrated that spraying with humic-acid for maize under intercropping with soybean was the additional benefit, which cause increase in growth, yield and chemical constituents of both crops in addition to declining 50% of nitrogen requirements, the pollution and production costs. Khan *et al.* (2019) stated that application of humic-acid may be recommended to improve growth ,quality of maize yield in similar environmental conditions and protein percentage, moreover foliar maize plants with humic-acid at 8 ml/L significantly increased plant height, plant dry weight, chlorophyll content, 500 grain weight, number of grains/ear and grain yield.

Ears and kernels rot are one of the most imperative disease disturbing on maize crop in Egypt, which can effect yield fatalities up to 4 8% of the total production and caused by *Fusarium verticililoides, Aspergillus flavus, and A. niger* fungi (Vigier *et al.*, 2001). HA could encourage the activity of the first enzyme in the phenylpropanoid path at the level of gene appearance (Lewis *et al.*, 2011). The foliar application of HA progresses this antique mechanism dropping plant infection (Olivares *et al.*, 2015), as well as enhancing plant protection (Hernandez *et al.*, 2014). Finally, HA is concerned in the augmentation of plant protection in opposition to infestation, Joshi *et al.* (2014) nearby the list of pathogens and pests controlled throughout vermin-compost application.

Economic, societal and environmental concerns are imposing changes in our agriculture models. In particular, there is a global trend towards re-introducing intercropping is a subset of diverse cropping systems that provide multiple eco-systemic effects including disease control (Gaba *et al.*, 2015).

Therefore, this research was established to study the effect of nitrogen fertilizer and humic-acid foliar spraying levels on growth, yield and its attributes, as well as ,ear rot disease of maize in intercropping system under the environmental conditions of Kafrelsheikh Governorate, Egypt.

MATERIALS AND METHODS

Two field trials were executed at Sakha Agricultural Researches Station Farm, Agricultural Research Center, Egypt, during 2017 and 2018 seasons to revision the effect of N-levels and spraying with humic-acid on growth, yield and its attributes as well as rot disease of intercropped maize with soybean.

The field experiments were executed in split-plot design through three replicates. The main-plots were dispersed to levels of nitrogen (100, 110 and 120 kg N/fed). The ammonium nitrate (33.5 % N) fertilizer was the form of nitrogen which applied for in two equivalent portions, one half just before the first irrigation and the other half before the second irrigation. The sub-plots were allocated to four levels of humic-acid as spraying (without humic acid, 2.5, 5.0 and 7.5 g/liter water in each spraying). Foliar spraying until saturation point with aforementioned humic-acid levels was carried out at 200 Liter/fed three times after 15, 30 and 45 days from planting.

Every sub-plot (experimental basic piece) incorporated three terraces, each of 1.4 m width and 3.0 m length, outcome an area of 12.6 m^2. The previous winter crop was flax (*Linum usitatissimum* L.) in both seasons. Maize was planted on both sides of terraces (140 cm width) at a distance of 50 cm apart (two plants/hill), resulting plant density of 24000 plants/fed (100 % of its pure stand). However, soybean was intercropped with maize by planting in two rows on the back of terraces, 30 cm apart, at a distance of 15 cm between hills and leaving two plants/hill, resulting plant density of 93334 plants/fed (50 % of its pure stand). In addition to the solo cultivation of both crops maize and soybean as recommendations of Ministry of Agriculture and Land Reclamation was done. Yellow maize hybrid (Three Way Cross, TWC) 352 and soybean Giza 111 cultivar at the recommended seeding rate were sown on 11th and 9th June in 1st and 2nd seasons, correspondingly.

The soil samples from the experimental positions were connected as of the upper 30 cm soil surface during land preparation in both 2017 and 2018 seasons, and then laboratory analyzed and their physical and chemical properties are shown in Table 1. Both mechanical and chemical analyses of the soil were carried out by following the method described by Page (1982).

Table 1. Averages of several properties of physical and chemical of the experimental site through both seasons.

Soil analyses		2017	2018
A: Mechanical analysis:			
Sand %		9.16	9.21
Silt %		29.36	29.34
Clay %		61.48	61.45
Texture		Clayey	Clayey
B: Chemical analysis:			
Organic matter %		1.17	1.10
Total N %		0.12	0.12
Total carbonate %		61.48	61.48
CEC meq/100 g soil		61.48	61.48
SP %		78.50	78.35
SAR		4.56	4.78
Available mg/kg	N	30.00	28.40
	P	9.75	8.45
	K	285.70	265.00
Soluble cations meq/L	Ca^{++}	7.46	6.10
	Mg^{++}	9.36	8.41
	Na^{+}	13.03	12.60
	K^{+}	0.31	0.35
Soluble anions meq/L	CO_3^{-}	0.00	0.00
	HCO_3^{-}	2.50	2.65
	Cl^{-}	10.56	9.50
	sO_4^{-}	17.09	16.87
pH		7.95	7.98
EC ds/m		3.02	3.06

Ordinary calcium superphosphate fertilizer (15.5 % P_2O_5) was applied as one dose for all plots during soil preparation at the rate of 150 kg/fed. Potassium sulphate (48 % K_2O) at the rate of 50 kg/fed was applied for experimental units before the second irrigation. The other agricultural practices for maize and soybean were kept the same as normally practiced according to the recommendations of Ministry of Agriculture and Land Reclamation, except for the factors under study.

Harvesting was done for both maize and soybean on 30th September and 8th October in the first and second seasons, respectively.

Recorded data:

No. of days from planting to 50 % tasseling and silking for maize plants were dogged as the number of days from planting to 50 % tasseling and silking of each sub-plot plants.

At harvest time, random samples of five guarded plants of both maize and soybean were taken from each sub-plot to determine the following characters:

A- Maize characters:

Plant height (cm),ear height (cm),ear position (%),stem diameter (cm), ear leaf area (cm^2) of topmost, ear length (cm),ear diameter (cm),number of rows/ear, number of grains/row, ear weight (g), ear grains weight (g), 100-grain weight (g) and shelling (%). Grain yield (ardab/fed) was adjusted to 15.5 % moisture content of each sub-plot, then converted to ardab per feddan (ardab = 140 kg).

B- Ear rot disease of maize:

According to El-Sharkawy, (2004) percentage of infection and disease severity were assessed in selected 5 ears and calculated using the following formula:

Infection% = No. of infected ears/total ears x 100.

Disease severity %= mean no. of infected grains in ears/ mean total grains in ears x 100.

Ear rot disease severity of was based on the following rating scale which: 1 = 0%, 2 = 1 to 3%, 3 = 4 to 10%, 4 = 11 to 25%, 5 = 26 to 50%, 6 = 51 to 75%, and 7 = > 75% of grains exhibited symptoms of rot infection and mycelial growth according to Reid *et al.* 1996).

Ear rot disease efficiency %= Control - Treatment/Control x100.

Control as solo maize treatment.

C- Soybean characters:

Plant height (cm), number of branches/plant, number of pods/plant, number of seeds/pod, 100-seed weight (g) and seed yield (t/fed).

D- Competitive relationships:

The following competitive relationships was calculated:

1. **Land equivalent ratio (LER):** It was determined according to the following formula described by Willey and Rao (1980):

$$LER = \frac{Yab}{Yaa} + \frac{Yba}{Ybb}$$

Where: Yaa and Ybb were pure stand of crop, a (maize) and b(soybean), respectively. Yab is mixture yield of a crop and Yba is mixture yield b crop.

2. **Relative crowding coefficient (RCC) or K:** It was calculated according to De-Wit (1960) as follows: K = Kab x Kba

$$Kab = \frac{Yab \times Zba}{(Yaa - Yab)Zab} \qquad Kba = \frac{Yba \times Zab}{(Ybb - Yba)Zba}$$

Where: a is maize and b is soybean , respectively. b is percentage of the area occupied by soybean and Zba is percentage of the area occupied by maize.

3. **Aggressivity (A):** It was calculated according to Mc-Gilchrist (1965) as the following formula:

For crop (a),

$$A_{ab} = \frac{Y_{ab}}{Y_{aa} \; x \; Z_{ab}} - \frac{Y_{ba}}{Y_{bb} \; x \; Z_{ba}}$$

and for crop (b),

$$A_{ba} = \frac{Y_{ba}}{Y_{bb} \; x \; Z_{ba}} - \frac{Y_{ab}}{Y_{aa} \; x \; Z_{ab}}$$

Where:

Aab = Aggressively value for the component a (maize).

Aba = Aggressively value for the component b(soybean).

Yab is intercrop yield of maize, Zab is percentage of the area occupied by soybean.

E- Economic evaluation:

Net return from each treatment was calculated in Egyptian pounds (LE/ Fed) according to the Ministry of Agriculture and Land Reclamation, Economic Affairs Sector, Agricultural Statistics, where market price of maize was 380.0 and 405.0 LE/ ardab and soybean seed was 6.00 and 6.50 LE/kg in 2017 and 2018 seasons, respectively, as equation of **Heady and Dillon (1961)** as follows:

Gross income = total yield x price (LE)

Net return (LE) = gross income- total costs of production

Using "MSTAT-C" computer software package, all obtained data were statistically analyzed as published by Gomez and Gomez (1984) according to analysis of variance (ANOVA) for the split-plot design. As described by Snedcor and Cochran (1980), the differences among treatment means were compared by least significant of difference (LSD) method at 5 % level of probability.

RESULTS AND DISCUSSION

A-Maize:

1- Effect of nitrogen fertilizer levels:

Data in Tables 2 and 3 revealed that the effect of N-levels on maize growth, yield and its attributes (plant height, ear height, ear position, stem diameter, ear leaf area, ear length, ear diameter, number of rows/ear, number of grains/row, ear weight, ear grains weight, 100-grains weight and grain yield/fed) was significant in the two growing seasons. While, number of days from sowing to 50 % tasseling and silking and shelling percentage of maize plants did not significantly differed due to N-levels within together seasons. It can be stated that all studied growth, yield and its attributes of maize intercropped with soybean significantly increased as a result of increasing N-levels from 100 to 110 up to 120 kg/fed within together seasons. Thus, fertilizing maize plants intercropped with soybean with 120 kg N/fed produced the highest values of all studied characters within together seasons. Mineral fertilizing maize plants intercropped with soybean by 110 kg N/fed came in the second rank and the lowest values of these characters were resulted from fertilizing maize plants with 100 kg N/fed within together seasons. Grain yield/fed of maize increased markedly by 9.19 and 29.13 %, in 1st season, and by 8.69 and 29.77 %, in 2nd season with 120 kg N/fed, compared with fertilizing by 110 and 100 kg N/fed, respectively. However, grain yield/fed of intercropped maize fertilized with 120 kg N/fed reduced by 6.84 and 6.94 % compared with solo cultivation in the first and the second seasons, respectively. These results are attributed to the role of the N element in monitoring several basic physiological processes in maize plants such as the rate of photosynthesis and the accumulation of more divided metabolites into the plant's organs, reflecting better corn growth. Comparable results were in coincidence with those stated by Lomer *et al.* (2019), Jiang *et al.* (2019) and Mahmood *et al.* (2020).

2- Effect of foliar spraying by humic acid:

Data presented in Tables 2 and 3 showed that, humic-acid levels as foliar treatment (without, at 2.5, 5.0 and 7.5 g/liter water in each spraying) of maize plants exhibited significant effects on maize growth, yield and its attributed *i.e.* number of days from sowing to 50 % tasseling and silking, plant height, ear height, ear position, stem diameter, ear leaf area, ear length, ear diameter, number of rows/ear, number of grains/row, ear weight, ear grains weight, 100-grains weight and grain yield/fed within together seasons. While, shelling percentage insignificantly affected by spraying with humic-acid levels within together seasons. Spraying (after 15, 30 and 45 days from planting) with humic-acid (7.5 g/liter water in each spraying) of maize plants intercropped with soybean attained the highest values of maize growth, yield and its attributes during 2017 and 2018 seasons. However, spraying maize plants intercropped with soybean with humic-acid at the rate of 5.0 g/liter water in each spraying ranked secondly and followed by spraying with humic-acid at the rate of 2.5 g/liter water concerning its effect on maize growth, yield and its attributes within together seasons. On the contrary, control treatment (without treatment of humic acid) gave the lowest values of all studied maize growth, yield and its attributes in the two growing seasons. Grain yield/fed of maize increased markedly by 6.61, 12.71 and 16.07 %, in the first season, and by 6.75, 12.48 and 16.83 %, in the second seasons when spraying with humic-acid at the rates of 2.5, 5.0 and 7.5 g/liter, compared with without spraying with humic acid, respectively. However, grain yield/fed of intercropped maize sprayed with humic-acid at the rate of 7.5 g/liter reduced by 11.72 and 11.25 % compared with solo cultivation in the first and the second seasons, respectively. Such effects of spraying with humic-acid at the highest level might have been due to the indirect beneficial effects of humic-acid on soil fertility, structure and microbial population, as well direct favorable effects on various biochemical effects at cell wall, membrane and cytoplasm, including increasing photosynthesis and respiration rates, enhanced protein synthesis and plant hormone like activity involved in plant growth (shoot and root) stimulation and nutrient uptake and increasing yield. These results are in compatible with those recorded by El-Shafey and Zen El- Dein (2016), Khan *et al.* (2019) and Mahmood *et al.* (2020). One of the major impacts of humic substances on plant growth is the strengthening in nutrient uptake and the elongation of the lateral root growth, often predictable as "auxin-like effect," which is a result of the initiation of ATPase activity in the plasma covering (Zandonadi *et al.*, 2007).

Table 2. Maize growth characters as affected by N-levels and spraying with humic-acid levels in addition to their interaction through 2017 and 2018 seasons.

Characters		Number of days to 50 % tasseling		Number of days to 50 % silking		Height of the plant (cm)		Height of the ear (cm)		Ear position (%)		Stem diameter (cm)		Ear leaf area (cm^2)	
Treatments		**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
							N-levels:								
100 kg N/fed		58.16	58.66	61.91	61.75	216.2	214.3	122.3	120.5	56.55	56.22	2.058	1.991	627.6	620.0
110 kg N/fed		58.33	59.08	62.08	62.33	223.0	221.5	130.5	129.0	58.56	58.27	2.243	2.198	702.3	694.9
120 kg N/fed		58.91	59.33	62.41	62.66	232.0	229.8	140.2	138.2	60.47	60.18	2.463	2.424	776.1	768.0
LSD at 5 %		NS	NS	NS	NS	3.7	4.1	5.5	6.0	1.29	1.35	0.153	0.169	34.9	35.6
							Spraying with humic-acid (HA) levels:								
Without		57.66	58.33	60.88	61.44	220.3	217.8	127.5	125.6	57.73	57.51	2.142	2.088	665.1	657.2
2.5 g HA		58.00	58.66	61.66	61.88	223.1	221.1	128.8	127.2	57.84	57.63	2.226	2.173	690.7	681.7
5.0 g HA		58.66	59.22	62.55	62.44	224.2	222.5	131.7	130.3	58.81	58.51	2.279	2.232	717.8	709.6
7.5 g HA		59.55	59.88	63.44	63.22	227.5	226.0	136.0	133.8	59.73	59.25	2.372	2.324	734.5	728.9
LSD at 5 %		1.10	0.95	0.90	0.82	4.7	5.1	6.6	7.0	1.43	1.49	0.117	0.108	20.3	19.6
							Interaction:								
100 Kg N/fed	Without	58.00	58.33	61.33	61.33	213.3	210.3	118.3	116.0	55.46	55.16	1.887	1.827	574.7	568.8
	2.5 g HA	57.66	58.33	61.33	61.33	216.6	214.3	120.3	118.3	55.53	55.23	2.067	1.963	623.0	610.3
	5.0 g HA	58.00	58.66	62.33	61.66	216.6	215.3	122.6	121.3	56.61	56.35	2.113	2.050	650.8	644.4
	7.5 g HA	59.00	59.33	63.33	62.66	218.3	217.3	128.0	126.3	58.62	58.16	2.163	2.123	661.9	656.7
110 kg N/fed	Without	57.33	58.33	60.33	61.33	220.3	218.3	128.6	127.3	58.39	58.33	2.163	2.103	686.7	679.4
	2.5 g HA	57.66	58.66	62.00	62.00	222.6	221.0	129.3	128.0	58.09	57.92	2.177	2.153	695.7	688.4
	5.0 g HA	58.66	59.33	62.33	62.66	223.6	222.3	131.0	129.6	58.65	58.32	2.290	2.237	711.8	701.0
	7.5 g HA	59.66	60.00	63.00	63.33	230.0	228.0	137.0	135.3	59.57	59.37	2.433	2.403	753.4	746.4
120 kg N/fed	Without	57.66	58.33	61.00	61.66	225.6	224.3	133.3	131.3	59.10	58.51	2.343	2.300	714.9	711.1
	2.5 g HA	58.66	59.00	61.66	62.33	227.3	225.0	135.6	133.6	59.67	59.41	2.377	2.333	733.9	723.4
	5.0 g HA	59.33	59.66	63.00	63.00	232.3	230.0	141.6	140.0	61.16	60.87	2.433	2.410	790.7	783.4
	7.5 g HA	60.00	60.33	64.00	63.66	238.6	236.3	146.6	144.0	61.47	61.07	2.610	2.550	826.7	819.0
LSD at 5 %		NS	NS	NS	NS	8.9	9.4	10.0	10.4	3.01	2.83	0.263	0.259	34.8	36.7
Solo maize		60.0	61.0	63.0	64.0	241.0	238.0	144.0	141.0	59.83	61.17	2.740	2.66	847.2	837.5

3- Effect of interaction:

The interaction between N-levels and spraying with humic-acid levels under intercropping system of maize and soybean illustrate significant effect on maize growth, yield and its attributes (plant height, ear height, ear position, stem diameter, ear leaf area, ear length, ear diameter, ear weight, ear grains weight, 100-grain weight and grain yield/fed) within together seasons (Tables 2 and 3). However, no. of days from sowing to 50 % tasseling and silking, no. of rows/ear, number of grains/row and shelling percentage showed insignificant effect as a result of the interaction between mineral N-levels and spraying with humic-acid levels under association system of maize and soybean within together seasons. The maximum values of plant height, ear height, ear position, stem diameter, ear leaf area, ear length, ear diameter, ear weight, ear grains weight, 100-grain weight and grain yield/fed of maize were obtained from spraying by humic-acid (7.5 g/L) of maize plants intercropped with soybean and fertilizing with 120 kg N/fed within together seasons, followed by spraying with humic-acid (5.0 g/L) and fertilizing with 120 kg N/fed then spraying with humic-acid (7.5 g/L) and fertilizing with 110 kg N/fed under intercropping system of maize and soybean in the two seasons. While, the lowest values were obtained from fertilizing with 100 kg N/fed without spraying with humic-acid under associating system of maize and soybean within together seasons. Availability of micronutrients such as iron can be improved with humic substances, not only by chelation but also by promoting the root capability to uptake nutrients from the soil solution (Zanin *et al.*, 2019).

Table 3. Yield and yield components of maize as affected by N-levels and spraying with humic-acid levels in addition to their interaction through 2017 and 2018 seasons.

Characters		Ear length (cm)		Ear diameter (cm)		Number of rows/ear		Number of grains/row		Ear weight (g)		Ear grains weight (g)		Shelling (%)		100-grain weight (g)		Grain yield (ardab/fed)	
Treatments		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
N-levels:																			
100 kg N/fed		16.41	16.15	4.45	4.40	17.53	17.30	35.43	34.86	136.9	135.1	109.4	107.5	79.88	80.19	22.50	22.05	18.78	18.31
110 kg N/fed		17.45	17.22	4.65	4.62	18.30	18.06	38.40	37.98	162.0	159.8	126.5	126.8	78.06	79.43	23.75	22.79	22.21	21.86
120 kg N/fed		19.33	19.00	4.93	4.87	19.27	19.05	41.53	41.03	177.0	174.8	141.1	139.1	79.72	79.54	25.75	25.05	24.25	23.76
LSD at 5 %		1.52	1.43	0.40	0.36	0.79	0.87	2.04	1.92	11.0	10.3	6.0	5.6	NS	NS	1.02	0.96	0.81	0.77
Spraying with humic-acid (HA) levels:																			
Without		16.16	16.92	4.57	4.52	17.87	17.68	36.82	36.33	145.4	143.4	115.5	113.5	79.43	79.24	22.44	21.84	19.98	19.55
2.5 g HA		17.53	17.21	4.63	4.59	18.23	17.97	38.13	37.60	155.6	153.7	120.9	122.0	77.77	79.39	23.66	22.70	21.30	20.87
5.0 g HA		17.84	17.60	4.70	4.65	18.44	18.23	38.93	38.48	164.4	162.4	131.3	129.5	79.85	80.65	24.55	23.92	22.52	21.99
7.5 g HA		19.38	18.11	4.81	4.76	18.93	18.66	39.93	39.42	169.1	166.9	135.0	132.9	79.84	79.60	25.33	24.74	23.19	22.84
LSD at 5 %		1.02	1.03	0.20	0.17	0.78	0.74	1.70	1.68	6.3	6.8	6.1	5.5	NS	NS	1.21	1.31	1.03	1.05
Interaction:																			
100 kg N/fed	Without	15.10	15.80	4.36	4.27	17.06	17.00	32.73	32.20	113.9	112.0	90.6	88.6	79.57	79.06	21.33	20.93	15.62	15.25
	2.5 g HA	16.33	15.93	4.45	4.40	17.46	17.13	35.46	34.73	136.4	134.9	108.2	106.4	79.39	78.85	22.33	21.80	18.70	18.10
	5.0 g HA	16.53	16.30	4.47	4.44	17.73	17.50	36.60	36.13	146.4	144.4	118.0	116.5	80.64	83.20	23.00	22.46	20.07	19.62
	7.5 g HA	17.70	16.56	4.54	4.50	17.86	17.60	36.93	36.40	151.0	149.0	120.8	118.7	79.94	79.66	23.33	23.03	20.72	20.27
110 kg N/fed	Without	16.00	16.76	4.59	4.55	17.86	17.66	37.60	37.13	154.8	152.6	123.2	121.7	79.53	79.84	22.33	21.43	21.23	20.85
	2.5 g HA	17.33	17.06	4.64	4.59	18.16	18.00	38.00	37.73	157.7	155.6	118.5	125.4	75.11	80.58	23.33	21.66	21.63	21.28
	5.0 g HA	17.46	17.30	4.69	4.65	18.53	18.20	38.66	38.26	164.8	162.5	129.6	127.8	78.63	78.67	24.00	23.50	22.61	22.21
	7.5 g HA	19.00	18.63	4.82	4.78	19.06	18.80	40.93	40.33	172.7	170.5	136.1	134.3	78.98	78.63	25.33	24.63	23.58	23.25
120 kg N/fed	Without	17.40	18.20	4.78	4.74	18.70	18.40	40.13	39.66	167.5	165.5	132.6	130.4	79.18	78.81	23.66	23.16	23.07	22.55
	2.5 g HA	18.93	17.76	4.70	4.70	18.66	18.40	39.33	38.80	170.6	168.5	134.7	132.5	78.83	78.75	25.33	24.56	23.39	23.13
	5.0 g HA	19.53	19.20	4.93	4.86	19.06	19.00	41.53	41.06	182.1	180.2	146.2	144.3	80.27	80.08	26.66	25.80	24.89	24.13
	7.5 g HA	21.46	20.00	5.20	5.10	20.26	20.00	43.53	43.06	185.7	183.2	149.7	147.5	80.61	80.51	27.33	26.63	25.47	25.13
LSD at 5 %		2.25	2.16	0.51	0.56	NS	NS	NS	NS	8.3	9.2	9.6	9.3	NS	NS	1.63	1.70	1.34	1.24
Solo maize		22.80	22.20	5.55	5.47	21.30	21.00	45.30	44.70	189.0	187.3	152.0	150.2	80.42	80.19	28.67	28.20	25.91	25.41

B- Ear rot diseases:

1- Effect of nitrogen fertilizer levels:

The data in Table 4 revealed that, the effect of N-levels on maize ear rot disease severity under natural infection was significant in the two growing seasons. Increasing nitrogen fertilizer from 100 to 120 kg N/fed (recommended one) significantly reduced ear rot disease and the differences among them were significant under intercropping system of maize and soybean within together seasons. Fertilizing maize plants intercropped with soybean with the recommended nitrogen fertilizer (120 kg N/fed) consequently good both of plants growth and ears characters (table2,3) this led to confirm the highest disease reduction within together seasons, *i.e.* 48.21 and 44.23%, the lowest infection, *i.e.*18.57 and 18.41%, and disease severity ranting 4 . Whereas, fertilizing maize plants intercropped with soybean with 110 kg N/fed ranked secondly to disease past fertilizing with 120 kg N/fed within together seasons. On the other side, the highest values of ear rot disease were resulted from fertilizing maize plants intercropped with soybean with the lowest level of nitrogen fertilizer (100 kg N/fed) within together seasons and control (solo maize). The results suggested that, optimum level of N fertilization may be reduced ear rot disease to maize as to Abro *et al.* (2013). Phelan *et al.* (1995) reported that, possibility reduction of susceptibility of maize plants with adequate fertilizer to vulnerable fusarium (ear rot pathogen) due to differences in plant health resulting from soil fertility management. Ferrigo *et al.* (2014) added that, plants suffering from abiotic stress are characterized by lower crop yield and quality, prone to fungal infection and their toxins. Alternatively, delayed physiological maturity due to nitrogen supplementation gave longer colonization time to fungi, Khattak and Khalil (2009). Additionally, Arino *et al.*, (2009) reported that, oversupply of nitrogen can potentially increase virulence of pathogens as it becomes toxic to plants.

2- Effect of foliar spraying by humic acid:

The studied humic-acid levels as spraying of maize plants intercropped with soybean exhibited significant effects on maize ear rot disease severity percentage under natural infection in the two growing seasons (Table 4). Spraying after 15, 30 and 45 days from planting with humic-acid in the form of potassium humate at the level of 7.5 g/liter water in each spraying of maize plants intercropped with soybean resulted in the lowest values of ear rot disease during the two summer seasons of 2017 and 2018. Nevertheless, spraying maize plants intercropped with soybean with humic-acid at the level of 5.0 g/liter water in each spraying ranked secondly after application the highest level of humic-acid ,while spraying with humic-acid at the rate of 2.5 g/liter water concerning its lowest effect on maize ear rot disease infection, ranged from 21.61-26.21 % , efficiency against ear rot disease ranged from 21.46-34.29% and disease severity ranting, *i.e.* 4-5 within together seasons. In contrast, control (solo maize) and treatment without spraying with humic-acid recorded the highest ear rot disease infection ranged from 28.05-35.86% and disease severity rating 5 in the two growing seasons. Results supported by finding of Ertani *et al.* (2011), they found that HA spraying increase of phenolic compounds like phenylpropanoid reducing plant infection by enhancing plant defense modulating of antioxidant, phenols, enzymes (Olivares *et al.*, 2015), direct effect against plant pathogens (Liu *et al.*, 2019) and microbial physical protection (Kaiser *et al.*, 2019).

Table 4. Ear rot disease severity and efficiency of maize under natural infection as affected by N-levels and spraying with humic-acid levels in addition to their interaction through 2017 and 2018 seasons.

Characters / Treatments		Disease severity rating		Ear rot Disease severity of %		Ear rot Disease efficiency %	
		2017	2018	2017	2018	2017	2018
N-levels:							
100 kg N/fed		5	5	31.55	30.25	12.02	8.03
110 kg N/fed		4	4	25.77	25.48	28.13	22.52
120 kg N/fed		4	4	18.57	18.41	48.21	44.23
LSD at 5 %		-	-	0.938	4.406	0.168	0.679
Spraying with humic-acid (HA) levels:							
Without		5	5	28.44	28.05	20.69	14.72
2.5 g HA		5	5	26.21	25.83	26.91	21.46
5.0 g HA		4	4	24.39	23.41	31.98	32.17
7.5 g HA		4	4	22.15	21.61	38.23	34.29
LSD at 5 %		-	-	1.569	1.170	3.021	0.997
Interaction:							
100 kg N/fed	Without	5	5	34.33	32.67	4.26	0.67
	2.5 g HA	5	5	33.33	31.01	7.05	5.74
	5.0 g HA	5	5	30.33	28.67	15.49	12.86
	7.5 g HA	5	5	28.18	28.66	21.50	12.84
110 kg N/fed	Without	5	5	27.33	28.33	23.78	13.86
	2.5 g HA	4	5	25.33	26.60	29.34	19.12
	5.0 g HA	4	4	25.83	24.23	27.96	26.33
	7.5 g HA	4	4	24.60	22.83	31.39	30.58
120 kg N/fed	Without	4	4	23.66	23.02	34.02	29.97
	2.5 g HA	4	4	19.96	20.09	44.33	38.91
	5.0 g HA	4	4	17.01	17.33	52.59	47.30
	7.5 g HA	4	4	13..67	13.33	61.87	59.48
LSD at 5 %		-	-	6.262	4.804	0.156	0.358
Control (Solo maize)		5	5	35.86	32.89	-	-

Disease severity were assessed based on the following rating scale as follows: 1 = 0%, 2 = 1 to 3%, 3 = 4 to 10%, 4 = 11 to 25%, 5 = 26 to 50%, 6 = 51 to 75%, and 7 = > 75% disease infection. Reid *et al.* (1992).

3- Effect of interaction:

Maize ear rot disease severity under natural infection was significantly affected by the interaction between N-levels and spraying with humic-acid levels under intercropping system of maize and soybean within together seasons (Table 4). Spraying with humic-acid at the level of 7.5 g/liter water and fertilizing with 120 kg N/fed recorded the lowest values of ear rot disease infection, *i.e.* 13.33 and 13.67 % , disease severity rating, *i.e.* 4 and the efficiency against the disease were 59.48 and 61.87 % under intercropping system of maize and soybean within together seasons followed by same one of humic-acid at the level of 5.0 g/liter water and fertilizing with 120 kg N/fed which was the second of maize ear rot disease under intercropping system of maize and soybean within together seasons. The highest values of maize ear rot disease infection, *ie.* 35.86 and 32.89 % and severity rating 5 were obtained with control (solo maize) and treatment of without spraying with humic-acid and mineral fertilizing with 100 kg N/fed within together seasons ,*i.e.*34.33 and 32.67% and disease rating 5. Other treatments infection ranged from 33.33 to 19.96 % and ear rot efficiency from 7.05-44.33% and disease rating from4- 5. Understanding mechanisms of plant response and effect for the humic in the field on carbon and nitrogen cycles, this is related to primary metabolism (Canellas *et al.*, 2019). Humic substances also interferes with secondary metabolism by altering gene expression and changing the content of chemical compounds in plant cells, such as those related to the Krebs cycle, metabolism of nitrate and phosphorus, glycolysis, and photosynthesis (Lotfi *et al.*, 2018).. HS is the interaction with auxin, jasmonic acid and abscisic acid by phytohormonal regulation in the root, which are well-known plant hormones for the stress of drought and salinity (Ali *et al.*, 2020) , synthesis of flavonoids, which are involved in the interception of ultraviolet (UV) as an adaptive mechanism preventing UV in plant physiology (Hollósy, 2002), increase in phenolic compounds (Ertani *et al.*, 2011) .

Effect of intercropping on plant disease was reported by many scholars and occurrence of many diseases, *i.e.* intercropping maize/pepper reduced blight in pepper (Yang, 2014), intercropping susceptible/ resistant barley decreased stem rust severity, increasing of yield than mono culture (Lie *et al.*, 2014) and strongly reduction of microbial disease in intercropping system (Li *et al.*, 2009), 73% of intercrop-disease combination recorded reduction and only 7% recorded increase (Boudreeu, 2013). Intercropping had antimicrobial properties throughout plant allelochemicals of exudates like phenolic acids(commaric and cinnamic) described as major antifungal chemicals by non-host plants which protect neighboring crop plants by inhibiting of spores germination and mycelial growth (Hao *et al.*, 2010), decompositions, leaching or volatilization (Massalah *et al.*, 2017).

C- Soybean:

1- Effect of nitrogen fertilizer levels:

N-levels (100, 110 and 120 kg N/fed) significantly affected soybean growth, yield and its attributes (plant height, number of branches/plant, number of pods/plant, number of seeds/pod, 100 – seed weight and seed yield/fed) showed enhancement of maize and soybean with associating system in the two growing seasons as data exposed in Table 5. Increasing mineral nitrogen fertilizer from 100 to 110 and 120 kg N/fed significantly increased all studied soybean growth, yield and its attributes and the differences among them were significant under intercropping system of maize and soybean within together seasons. Consequently, fertilizing soybean plants intercropped with maize by 120 kg N/fed produced the highest values of all studied growth, yield and its attributes of soybean (plant height, number of branches/plant, number of pods/plant, number of seeds/pod, 100 – seed weight and seed yield/fed) within together seasons. Whereas, fertilizing soybean plants intercropped with maize with 110 kg N/fed ranked secondly past fertilizing with 120 kg N/fed with respect to soybean growth, yield and its attributes within together seasons. On the other side, the lowest values of growth, yield and its attributes of soybean were resulted from mineral fertilizing soybean plants intercropped with maize with 100 kg N/fed in the two growing seasons. Seed yield/fed of soybean intercropped with maize increased markedly by 9.59 and 29.08 %, in the first season, and by 9.87 and 30.09 %, in the second seasons when mineral fertilizing with 120 kg N/fed, compared with 110 kg N/fed and 100 kg N/fed, respectively. The increases in growth, yield and its attributes of soybean crop as a result of increasing nitrogen fertilizer level up to 120 kg N/fed can be ascribed to the role of nitrogen in protoplasm and chlorophyll formation, enhancement meristematic activity and cell division, consequently increases cell size, leaf area and photosynthetic activity, which caused increases in plant growth characters, yield and its attributes. Rashwan and Zen El- Dein (2017) confirmed these results, who stated that number of pods ,branches, seed yield per plant and per fed of soybean were increased with the increment in nitrogen level up to 120 kg/fed.

Table 5. Growth, yield and yield attributes of soybean as affected by N-levels and spraying with humic-acid levels in addition to their interaction through 2017 and 2018 seasons.

Characters		Plant height (cm)		Number of branches/plant		Number of pods/plant		Number of seeds/pod		100 – seed weight (g)		Seed yield (t/fed)	
Treatments		2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
N-levels:													
100 kg N/fed		93.9	91.5	2.917	2.583	27.08	24.83	2.058	1.883	13.70	13.63	0.478	0.462
110 kg N/fed		99.3	97.5	3.833	3.667	39.33	37.58	2.275	2.142	14.47	14.39	0.563	0.547
120 kg N/fed		105.0	103.0	4.583	4.333	48.00	45.66	2.425	2.333	15.58	15.50	0.617	0.601
LSD at 5 %		3.8	3.4	0.500	0.509	3.63	3.82	0.183	0.177	0.41	0.44	0.016	0.019
Spraying with humic-acid (HA) levels:													
Without		96.6	94.3	3.333	3.111	34.11	32.22	1.900	1.767	14.10	14.03	0.507	0.490
2.5 g HA		98.6	96.5	3.667	3.556	37.22	35.44	2.189	2.033	14.45	14.37	0.530	0.517
5.0 g HA		100.2	98.1	3.889	3.556	39.11	36.77	2.322	2.200	14.71	14.63	0.569	0.554
7.5 g HA		102.2	100.4	4.222	3.889	42.11	39.66	2.600	2.478	15.07	14.99	0.604	0.586
LSD at 5 %		3.9	4.1	0.294	0.306	4.29	4.16	0.315	0.301	0.34	0.36	0.013	0.010
Interaction:													
100 kg N/fed	Without	90.3	88.0	2.333	2.000	22.00	20.00	1.600	1.400	13.16	13.10	0.436	0.413
	2.5 g HA	93.3	90.3	3.000	2.667	26.00	24.00	2.067	1.867	13.61	13.53	0.462	0.447
	5.0 g HA	95.3	93.0	3.000	2.667	28.33	25.33	2.167	1.967	13.88	13.81	0.486	0.475
	7.5 g HA	96.6	95.0	3.333	3.000	32.00	30.00	2.400	2.300	14.14	14.07	0.527	0.512
110 kg N/fed	Without	98.0	95.0	3.667	3.333	35.33	33.66	1.967	1.867	14.15	14.07	0.529	0.515
	2.5 g HA	99.0	97.0	3.667	3.667	38.66	37.00	2.167	2.033	14.36	14.28	0.547	0.533
	5.0 g HA	99.6	98.0	4.000	3.667	40.33	38.33	2.400	2.300	14.51	14.43	0.576	0.560
	7.5 g HA	103.6	102.3	4.333	4.333	47.00	45.33	2.567	2.367	15.38	15.31	0.599	0.581
120 kg N/fed	Without	101.6	100.0	4.000	4.000	45.00	43.00	2.133	2.033	14.99	14.93	0.555	0.542
	2.5 g HA	100.6	100.0	4.000	4.000	43.00	41.33	2.333	2.200	14.87	14.79	0.581	0.570
	5.0 g HA	105.6	103.3	4.667	4.333	48.66	46.66	2.400	2.333	15.73	15.66	0.645	0.627
	7.5 g HA	109.3	106.3	5.333	4.667	51.33	47.66	2.833	2.767	16.22	16.13	0.685	0.667
LSD at 5 %		5.8	6.2	0.705	0.658	5.35	5.12	0.283	0.264	0.55	0.45	0.027	0.028
Solo soybean		107.0	105.0	6.330	5.700	55.33	53.33	3.000	2.900	16.33	16.25	1.444	1.412

2- Effect of foliar spraying by humic acid:

The studied humic-acid levels as spraying of soybean plants intercropped with maize (without, spraying with humic-acid at the rates of 2.5, 5.0 and 7.5 g/liter water in each spraying after 15, 30 and 45 days from planting) exhibited significant effects on soybean growth, yield and its attributes *i.e.* plant height, number of branches/plant, number of pods/plant, number of seeds/pod, 100 – seed weight and seed yield/fed within together seasons (Table 5). Spraying with humic-acid at the level of 7.5 g/liter water of soybean plants intercropped with maize resulted in the highest values of soybean growth, yield and its attributes during 2017 and 2018 seasons. Nevertheless, spraying soybean plants intercropped with maize with humic-acid at the level of 5.0 g/liter water ranked secondly and lowest one spraying with humic-acid at the rate of 2.5 g/liter water concerning its effect on soybean growth, yield and its attributes within together seasons. In contrast, control treatment *i.e.* without spraying with humic-acid produced the lowest values. Soybean seed yield/fed intercropped with maize increased markedly *i.e.* 4.54, 12.23 and 19.13 %, in the first season and 5.51, 7.97 and 19.59 %, respectively in the second seasons when spraying with humic-acid at the levels of 2.5, 5.0 and 7.5 g/liter as compared to without treatment of humic acid. The favourable effect of spraying with humic-acid at the highest level might have been attributed to enhance growth, nutrient uptake and yield as a result of its indirect and direct beneficial effects such as; enhancing soil fertility, structure and microbial population, increasing photosynthesis and respiration rates, enhanced protein synthesis and plant hormone like activity involved in plant growth. These results are in compatible with that recorded by El-Shafey and Zen El- Dein (2016).

3- Effect of interaction:

Soybean growth, yield and its attributes (plant height, number of branches/plant, number of pods/plant, number of seeds/pod, 100 – seed weight and seed yield/fed) were significantly precious by the interaction between N-levels and spraying by humic-acid levels with association system of maize and soybean in the two tested years (Table 5). The highest values of soybean plant height, number of branches/plant, number of pods/plant, number of seeds/pod, 100 – seed weight and seed yield/fed were obtained from spraying by humic-acid (7.5 g/L) of soybean plants intercropped with maize in addition fertilizing with 120 kg N/fed within together seasons. However, spraying with humic-acid (5.0 g/L) and fertilizing with 120 kg N/fed was the second best interaction treatment for soybean growth, yield and its attributes and followed by spraying with humic-acid (7.5 g/L) and fertilizing with 110 kg N/fed under intercropping system of maize and soybean within together seasons. While, mineral fertilizing with 100 kg N/fed without spraying with humic-acid produced the lowest values of soybean growth, yield and its attributes under intercropping system of maize and soybean within together seasons.

D- Competitive relationships:

The highest values of competitive relationships ,*viz.* land equivalent ratio (LER) and relative crowding coefficient (RCC) as presented in Tables 6 were obtained from treatment with humic-acid (7.5 g/L) of maize intercropped with soybean plants in addition fertilizing with 120 kg N/fed within together seasons. Nevertheless, spraying with humic-acid (5.0 g/L) of maize intercropped with soybean plants in addition fertilizing with 120 kg N/fed came in the second rank regarding the aforementioned competitive relationships traits within together seasons. While, the lowest values of LER and RCC were recorded by mineral fertilizing with 100 kg N/fed without spraying with humic-acid within together seasons. Concerning the Aggressivity (A), the highest value for maize and the lowest value for soybean were resulted from mineral fertilizing with 120 kg N/fed without spraying with humic acid, while, the lowest value for maize and the highest value for soybean were resulted from mineral fertilizing with 100 kg N/fed without spraying with humic-acid within together seasons.

Table 6. Land equivalent ratio, aggressivity and relative crowding coefficient of intercropping soybean with maize as affected by N-levels and spraying with humic-acid levels during 2017 and 2018 seasons.

Character		Land equivalent ratio			Aggressivity		Relative crowding coefficient			Land equivalent ratio			Aggressivity		Relative crowding coefficient		
Treatment		Lm	Ls	LER	Ag m	Ag s	K m	K s	K	Lm	L s	LER	Ag m	Ag s	Km	Ks	K
		2017 season								2018 season							
100 kg N/fed	Without	0.60	0.30	0.90	+0.02	-0.02	0.75	0.88	0.66	0.61	0.29	0.90	+0.02	-0.02	0.76	0.84	0.64
	250 g HA	0.72	0.32	1.04	+0.11	-0.11	1.28	0.96	1.22	0.72	0.32	1.04	+0.12	-0.12	1.27	0.94	1.19
	500 g HA	0.77	0.34	1.11	+0.14	-0.14	1.69	1.03	1.74	0.78	0.34	1.12	+0.15	-0.15	1.75	1.03	1.80
	750 g HA	0.80	0.36	1.16	+0.09	-0.09	1.97	1.17	2.29	0.81	0.36	1.17	+0.10	-0.10	2.05	1.16	2.37
110 kg N/fed	Without	0.82	0.37	1.19	+0.11	-0.11	2.23	1.17	2.62	0.83	0.36	1.19	+0.13	-0.13	2.39	1.17	2.79
	250 g HA	0.83	0.38	1.21	+0.10	-0.10	2.49	1.24	3.08	0.85	0.38	1.22	+0.12	-0.12	2.72	1.23	3.34
	500 g HA	0.87	0.40	1.27	+0.09	-0.09	3.37	1.35	4.55	0.88	0.40	1.28	+0.12	-0.12	3.73	1.33	4.98
	750 g HA	0.91	0.41	1.32	+0.10	-0.10	4.98	1.44	7.17	0.92	0.41	1.34	+0.13	-0.13	6.06	1.42	8.60
120 kg N/fed	Without	0.89	0.38	1.27	+0.16	-0.16	4.00	1.27	5.07	0.90	0.38	1.28	+0.18	-0.18	4.29	1.26	5.42
	250 g HA	0.90	0.40	1.31	+0.13	-0.13	4.57	1.37	6.25	0.92	0.40	1.32	+0.15	-0.15	5.67	1.37	7.79
	500 g HA	0.96	0.45	1.41	+0.08	-0.08	12.02	1.64	19.70	0.96	0.44	1.40	+0.09	-0.09	11.77	1.62	19.08
	750 g HA	0.98	0.47	1.46	+0.03	-0.03	28.51	1.83	52.24	1.00	0.47	1.47	+0.06	-0.06	12.37	1.82	22.49

m = maize ; s = soybean

E- Economic evaluation:

Concerning the economic evaluation of the interaction between N-levels and spraying with humic-acid levels during the two summer seasons 2017 and 2018, the data accessible in Table 7 apparent showed that the highest values of actual yield (LE), total income (LE), total cost (LE) and economic return (LE) of both maize and soybean crops were obtained from spraying with humic-acid (7.5 g/L) and fertilizing with 120 kg N/fed of maize plants intercropped with soybean within together seasons. However, the second best interaction treatment for economic evaluation was spraying with humic-acid (5.0 g/L) and fertilizing with 120 kg N/fed and followed by spraying with humic-acid (7.5 g/L) and fertilizing with 110 kg N/fed under intercropping system of maize and soybean within together seasons. While, the lowest values of actual yield (LE), total income (LE), total cost (LE) and economic return (LE) of both maize and soybean crops were recorded by mineral fertilizing with 100 kg N/fed without spraying with humic-acid under intercropping system of maize and soybean within together seasons. Economic are imposing changes in agriculture models. In particular, intercropping provided multiple eco-systemic effects including disease control (Gaba *et al.*, 2015).

Table 7. Effect of the interaction between N-levels and spraying with humic-acid levels on economic evaluation during the two summer seasons 2017 and 2018.

Treatments		Economic evaluation									
N-levels	Spraying with humic-acid levels	2017					2018				
		Actual Maize yield (LE)	Actual soybean yield (LE)	Total income (LE)	Total cost (LE)	Economic return (LE)	Actual Maize yield (LE)	Actual soybean yield (LE)	Total income (LE)	Total cost (LE)	Economic return (LE)
100 kg N/fed	Without	5935.6	2616.0	8551.6	2630.0	5921.6	6176.3	2684.5	8860.8	2935.0	5925.8
	2.5 g HA	7106.0	2772.0	9878	2750.0	7128.0	7330.5	2905.5	10236	2960.0	7276.0
	5.0 g HA	7626.6	2916.0	10542.6	2780.0	7762.6	7946.1	3087.5	11033.6	2985.0	8048.6
	7.5 g HA	7873.6	3162.0	11035.6	2810.0	8225.6	8209.4	3328.0	11537.4	3010.0	8527.4
110 kg N/fed	Without	8067.4	3174.0	11241.4	2835.0	8406.4	8444.3	3347.5	11791.8	3135.0	8656.8
	2.5 g HA	8219.4	3282.0	11501.4	2930.0	8571.4	8618.4	3464.5	12082.9	3160.0	8922.9
	5.0 g HA	8591.8	3456.0	12047.8	2965.0	9082.8	8995.1	3640.0	12635.1	3185.0	9450.1
	7.5 g HA	8960.4	3594.0	12554.4	3000.0	9554.4	9416.3	3776.5	13192.8	3210.0	9982.8
120 kg N/fed	Without	8766.6	3330.0	12096.6	3030.0	9066.6	9132.8	3523.0	12655.8	3335.0	9320.8
	2.5 g HA	8888.2	3486.0	12374.2	3110.0	9264.2	9367.7	3705.0	13072.7	3360.0	9712.7
	5.0 g HA	9458.2	3870.0	13328.2	3140.0	10188.2	9772.7	4075.5	13848.2	3385.0	10463.2
	7.5 g HA	9678.6	4110.0	13788.6	3200.0	10588.6	10177.7	4335.5	14513.2	3410.0	11103.2
Solo maize		-	-	9845.8	2755.0	7090.8	-	-	10291.1	2950.0	7341.1
Solo soybean		-	-	8664.0	1750.0	6914.0	-	-	9178.0	1955.0	7223.0

CONCLUSION

It can be concluded that to obtain the best land usage and economic return must be intercropping soybean with (100 % maize + 50 % soybean) and spraying with humic-acid at the level of 7.5 g/liter water in each spraying in addition mineral fertilizing with 120 kg N/fed under the environmental circumstances of Kafrelsheikh Governorate, Egypt.

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تأثير السماد النيتروجينى والرش الورقى بحمض الهيومك على انتاجية الذرة الشامية وفول الصويا وعلى عفن الكيزان للذرة الشامية

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تحت ظروف الحقل، تم إجراء تجربتين فى موسمى 2017و 2018بالمزرعة البحثية لمحطة البحوث الزراعية بسخا، مركز البحوث الزراعية لدراسة تأثير مستويات السماد النيتروجيني (100 و110 و120 كجم نيتروجين/ فدان) والرش الورقي بمستويات من حمض الهيوميك (بدون رش والرش الورقى بحمض الهيوميك بمعدلات 2,5 و 0,5 و 5و7 جم/لتر ماء في كل رشة) على النمو والمحصول ومكوناته وكذلك على مرض عفن الكيزان للذرة الشامية تحت نظام التحميل مع فول الصويا. تم تنفيذ التجارب الحقلية في تصميم القطع المنشقة مرة واحدة فى ثلاث مكررات. تم تخصيص القطع الرئيسية لمعدلات السماد النيتروجيني لكل من الذرة الشامية وفول الصويا. بينما تم تخصيص القطع المنشقة لمستويات الرش الورقى بحمض الهيوميك لكل من الذرة الشامية وفول الصويا. أظهرت النتائج التي تم الحصول عليها أن صفات النمو والمحصول ومكوناته لكل من الذرة الشامية وفول الصويا تحت نظام التحميل زادت معنوياً نتيجة لزيادة السماد النيتروجيني من 100 إلى 110 و120 كجم نيتروجين / فدان وأن المعدل الموصى به 120 كجم وحد ة ازوت للفدان لتقليل الاصابة وشدتها بمرض عفن الكيزان فى الذرة الشامية . أدى الرش الورقي ثلاث مرات بحمض الهيوميك بمعدل 5و7 جم / لتر ماء في كل رشة للحصول على أعلى القيم لصفات النمو والمحصول ومكوناته لكل من الذرة الشامية وفول الصويا، وسبب انخفاض فى الاصابة وشدتها بمرض عفن الكيزان فى الذرة الشامية تحت نظام التحميل خلال الموسمين. الاصابة تحت الظروف الطبيعية بمرض عفن الكيزان فى الذرة تأثرت معنويا بمعدلات التسميد النتروجينى ومستويات الرش بحمض الهيومك تحت نظام التحميل بين كل من الذرة وفول الصويا خلال موسمى الزراعة. يمكن التوصية بأن اعلى القيم لصفات النمو والإنتاجية والعلاقات التنافسية والدخل الكلى (11032) و (10588,60) جنيها والعائد الاقتصادي (بالجنيه) والمحصول ومكوناته لكل من الذرة الشامية وفول الصويا وأقل اصابة وشدة مرضية لعفن الكيزان فى الذرة الشامية تحت نظام التحميل على التوالى تم الحصول عليها بالرش الورقى ثلاث مرات بعد 15 و 30 و 45 يومًا من الزراعة بحمض الهيوميك بمعدل 5و7جم / لتر ماء في كل رشة مع معدل التسميد بـ 120 كجم نيتروجين / فدان تحت الظروف البيئية لمحافظة كفر الشيخ ، مصر.