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EFFECT OF MAIZE-SOYBEAN INTERCROPPING ON SOME FOLIAR FUNGAL DISEASES AND CROP CHARACTERISTICS

Ismail, A.E.A.; B.E.A. El-Laithy and Siham M.E. Abdel-Ghafour
Plant Pathology Research Institute, Agriculture Research Center, Giza, Egypt.

ABSTRACT

Increasing crop production by using intercropping is considered as one of the recent means which used for this goal. Maize-soybean intercropping was studied under different patterns to distinguish the best pattern for decreasing kernel and ear rot diseases of maize and pod, seed rot as well as leaf spot of soybean, with the optimal production of both crops. Three intercropping patterns were used. It was found that 2 x 2 pattern (two ridges of maize in alternation with two ridges of soybean) increased disease incidence for both crops, specially *F. moniliforme* var. zea, accompanied with decreasing the production characteristics of both crops. On the other hand, intercropping pattern 2 x 4 (two ridges of maize in alternation with four ridges of soybean) decreased diseases incidence and accordingly improved production characteristics for both crops. Generally, sole pattern of soybean produced the best crop productivity, but sole maize pattern produced moderate crop characteristics and disease incidence compared with 2 x 4 pattern which gave the lowest infection of Fusarium and highest crop production characteristics.

INTRODUCTION

Increasing the vertical production of Maize is an essential goal because of the limited agricultural area in Egypt. There are many agricultural practices adapted to increase grain production. One of the most important factors for improving the quantity and quality of the grain is controlling seed diseases. Kernel and ear rot diseases caused by *Fusrium moniliforme* Sheldon, *Diplodia sp.,* and *Aspergillus sp.* start at field and contain the damage during storage. (Sabet *et al.,* 1972; Vakali, 1985 and Bottalica and Logrieco, 1990) Soybean (*Glycine max* (L.) Merr) is legum crop, which contains high percentage of oil and protein. Many fungi cause seed rot which decrease the production of soybean, such as *Fusarium spp., Aspergillus spp.,* and others (Ismail, 1989 and Abd-Allah, 1991).

Maize - soybean intercropping studies showed an increase in maize seeds (Metwally, 1973; Singh *et al.,* 1973 and Finlay, 1974). Reduction of infection with complex stalk rots and increasing of yield was observed when planting soybean or cowpea under maize plants (Samra *et al.,* 1971; Anonymous, 1976 and Abd-El-Rahim *et al.,* 1984). Other studies showed that, intercropping of soybean with maize increased the total number of infected plants and stalk rot, but decreased the incidence of soybean downy mildew (Botros, 1988 and El-Gantiry *et al.,* 1993).

The aim of this work is to study the effect of different patterns of maize - soybean intercropping on ear and kernel rot diseases of maize and

also on soybean pod and seed rot as well as the morphological charactristics of the two crops.

MATERIALS AND METHODS

Three intercropping patterns were designed under the field condition two ridges of maize in alternation with two ridges of soybean and three ridges of maize in alternation with three ridges of soybean while the 3rd one was two ridges of maize in alternation with four ridges of soybean compared with sole cropping for each crop as a control.

This experiment was carried out under naturally infested soil in two governorates (El-Sharkia and El-Dakahlia) at the same growing season. Maize cultivar S.C. 10 and Clark soybean cultivar were used in these experiments. Randomized complete block design with 3.5 x 6 meters (1/250 feddan) for each plot was carried out. Each plot had 8 ridges, sole maize was sown at 10 - 15 May in three plots, using dry planting method. Maize seeds were sown by hand in hills (30 cm apart, 4 seeds / hill). Soybean seeds were swon on the two sides of the ridges (hill were 15 cm apart). Four seeds were sown in every hill and thinned to single plant / hill after 21 days from planting, and the normal cultural practices were followed.

Symptoms and fungal isolation:

Ear and kernel rots of maize are primarily caused by *Fusarium moniliforme, Deplodia zea* and *Aspergillus sp.* Infected ears become gray to brown, shrunk and may be completely rotted with pink mold growing between the ears and the adhering husks when ears are broken they show a white mold growing between the kernels and the tips of the kernels are discolored. Isolation from diseased parts was carried out on potato dexstros agar (P.D.A) medium and isolated fungi were identified according to Agrios, 1978. The percentage of fungal infection was estimated and percentage of disease severity was calculated as the ratio of the number of diseased kernels / ear to the number for ear kernels.

Maize and soybean plants characteristics were also estimated at the end of the season, under all different intercropping patterns, compared with sole cropping for each as control.

RESULTS AND DISCUSSION

Infection and severity of diseases:

Data in Tables (1 and 2) show that, the highest percentage of maize infection in El-Sharkia governorate by *F. moniliforme* (40 %) was observed under intrcrooping pasttern 2 x 2, while the lowest infection (11.0 and 9.0 %) was estimated under the pattern 2 x 4. No percentage of infection with *Diplodia zea* and *Aspergillus niger* were detected when maize plants was intercropping 3 x 3 and 2 x 2 or sole cropping. The highest percentage of infection (9.0 %) with *Aspergillus niger* was recorded when the intercropping pattern was 3 x 3 followed by 2 x 4. On the other hand, the percentage of infection with *Diplodia zea* were 10 % and 5 % under intercropping patterns

2 x 2 and 2 x 4 respectively. The same trend was recorded in El-Dakahlia governorate (Table 2).

Table (1): Effect of intercropping patterns on ear and kernel diseases of maize, caused by *F. moniliforme, Deplodia zea* and *Aspergillus sp.* in El-Sharkia governorate.

Pattern	*F. moniliforme*		*Deplodia zea*		*Aspergillus sp.*	
	Infection %	Severity	Infection %	Severity	Infection %	Severity
Sole	23.7	5.1	0.0	0.0	0.0	0.0
2 x 2	40.0	10.6	10.0	0.0	0.0	0.0
3 x 3	20.0	5.5	0.0	0.0	9.0	12.5
2 x 4	11.0	2.4	5.0	0.0	8.0	5.0
LSD at 5%	8.5	2.6	3.0	NS	4.66	4.5

Table (2): Effect of intercropping patterns on ear and kernel diseases of maize, caused by *F. moniliforme, Deplodia zea* and *Aspergillus sp.* in El-Dakahlia governorate.

Pattern	*F. moniliforme*		*Deplodia zea*		*Aspergillus sp.*	
	Infection %	Severity	Infection %	Severity	Infection %	Severity
Sole	22.00	4.00	0.0	0.0	0.0	0.0
2 x 2	38.00	10.00	8.00	0.0	0.0	0.0
3 x 3	20.00	4.00	0.0	0.0	0.0	14.0
2 x 4	9.00	3.00	6.00	0.0	0.0	7.0
LSD at 5%	7.4	2.25	2.8	NS	NS	5.5

Data of soybean fungal diseases are presented in Tables (3 and 4). Data indicated that, the soybean fungal diseases were totally higher under all intercropping patterns, except the intercropping pattern 2 x 4, which showed decreasing in the percentage pod and seed rot diseases (5.0 and 4.0 % respectively). The highest percentage of infection occurred under 2 x 2 intercropping pattern, 20.0 % pod rot, 15.0 % seed rot and 30 % leaves spot.

Table (3): Effect of intercropping patterns on the percentage of pod and seed rots as well as leaf spot diseases of soybean in El-Sharkia governorate.

Pattern	Infection with fungal diseases (%)		
	Pod rot*	Seed rot*	Leaf spot**
Sole	7.0	6.0	10.0
2 x 2	20.0	15.0	30.0
3 x 3	8.0	5.0	20.0
2 x 4	5.0	4.0	12.0
LSD at 5%	3.6	3.8	5.7

*** Pod and seed rot caused by: *Fusarium spp., Rhizoctonia solani, Diplodia sp., Rhizopus sp., Aspergillus sp.* and *Penicillum sp.***
**** Leaf spot caused by *Alternaria solani***

Table (4): Effect of intercropping patterns on the percentage of pod and seed rots as well as leaf spot diseases of soybean in El-Dakahlia governorate.

Pattern	Infection with fungal diseases (%)		
	Pod rot*	Seed rot*	Leaf spot**
Sole	11.00	9.00	15.00
2 x 2	27.00	18.00	32.00
3 x 3	15.00	9.00	28.00
2 x 4	6.00	7.00	16.00
LSD at 5%	5.8	6.6	8.7

*** Pod and seed rot caused by: *Fusarium spp., Rhizoctonia solani, Diplodia sp., Rhizopus sp., Aspergillus sp.* and *Penicillum sp.***
**** Leaf spot caused by *Alternaria solani***

Crop characteristics:

The effect of intercropping patterns of maize and soybean on maize plant characteristics is shown in Tables (5 and 6). No significant differences were observed between the four intrcropping patterns in case of length of ear (20.7, 20.9, 21.3, 21.2 cm), number of grains rows (11.3, 12.7, 10.0, 10.7), number of grains / ear (43.7, 45.3, 47.7, 48.3) and weight of 100 grains (55.0, 45.0, 50.0, 50 g). All other maize characteristics showed significant differences under the different patterns. Intercropping patterns 2 x 4 gave the highest weight of crop (68.3 g), weight of plant (1650 g) and area of leaf (871.0 cm^2). On the other hand, sole cropping of maize showed a moderate plant characteristics except in case of ear number / plot.

Soybean plant characteristics were estimated under the different intercropping patterns and sole cropping of soybean as shown in Tables (7 and 8).

There were no significant differences between plant length (114, 109, 122, 121 cm), number of branches (11.9, 8.9) and number of seeds / pod (4, 3, 3, 3) under the different patterns. While sole cropping of soybean gave the highest number of pods (55), number of clusters (29) and fresh weight of plant (125 g). On the other hand, intercropping pattern 2 x 4 showed the highest weight of 100 seeds (45 g), while the lowest (40 g) was estimated under the intercropping pattern 2 x 2.

Intercrroping of maize with soybean showed promising results. Percentage of ear and kernel disease severity of maize caused by *F. moniliforme* was 5.1 % under maize sole cropping, but under intercropping pattern (2 maize x 4 soybean), it was decreasesd to 2.4 % (Tables 1 and 2). The best maize plant characteristics, presented in the highest number of grains / ear, weight of crop, area of leaf and weight of plant were detected

under intercropping patterns (Tables 5 and 6). These results are in agreement with Metwally (1973) and Finaly (1974).

Table (7): Effect of intercropping patterns on soybean plant characteristics under field conditions in El-Sharkia governorate.

Pattern	Plant length (cm)	No. of branches /plant	No. of clusters /plant	No. of pods /plant	No. of leaves /plant	Fresh weight of plant (g)	No. of seeds /pod	Weight of 100 seeds (g)
Sole	114	11	29	55	43	125	4	43
2 x 2	109	9	18	30	48	80	3	40
3 x 3	122	9	18	31	49	85	3	42
2 x 4	121	9	20	19	43	90	3	45
LSD 5%	NS	NS	3.7	8.4	3.6	10.4	NS	2.2

Table (8): Effect of intercropping patterns on soybean plant characteristics under field conditions in El-Dakahlia governorate.

Pattern	Plant length (cm)	No. of branches /plant	No. of clusters /plant	No. of pods /plant	No. of leaves /plant	Fresh weight of plant (g)	No. of seeds /pod	Weight of 100 seeds (g)
Sole	125.6	12	34	60	45	145	5	45
2 x 2	135.5	13	22	38	50	155	4	48
3 x 3	134.9	9	25	40	56	123	3	43
2 x 4	122.8	9	26	25	38	112	4	40
LSD5%	4.6	2.3	5.7	10.4	9.6	12.6	NS	2.6

Reduction of maize diseases could be attributed to the interaction of maize and soybean root exudates which might change the population of soilmicroflora which affect the pathogens, (Teich, 1991 and Pronczuk *et al.,* 1992). On the other hand, intercropping pattern 2 x 2 gave the highest percentage of disease severity of kernel caused by *F. moniliforme,* (Tables 1 and 2) which could be attributed to the interaction of maize and soybean root exudates which might change the population of soil microflora which affect the pathogens, (Teich, 1991 and Pronczuk *et al.,* 1992). On the other hand, intercropping pattern 2 x 2 gave the highest percentage of disease severity of kernel caused by *F. moniliforme,* (Tables 1 and 2) which could be due to the increased temperature and relative humidity, which is more favorable for disease severity (Mesha, 1978; Botros, 1988 and El-Gantiry *et al.,* (1993). Increasing of maize disease severity followed by decreasing of plant characteristics was pronounced when obsering the lowest weight of 100 grains (45.0 g) and cobs (35.0 g). With regard to soybean, the intercropping pattern 2 x 4 was the best for decreasing pod and seed rot infection, but this pattern showed no advantage to improve soybean plant characteristics. On contrary, sole cropping of soybean, gave the lowest percentage of disease infection and the best soybean plant characteristics.

REFERENCES

Abd-Allah, E.F. (1991). Physiological and biochemical studies on mycotoxin produced by some fungi isolated from some foodstuffs. M. SC. Thesis, Botany Department, Faculty of Science, Zagazig University, Egypt.

Abd-El-Rahim, M.F.; H.M. Shata; A.M. El-Fahl; E.M. El-Assiuty and A.A. Gouda (1984). Cultural practices in relation to control of maize stalk rot complex. Agric. Res. Rev., 62: 63 - 74, Egypt.

Agrios, N.G. (1978). "Plant pathology" Academic Press, INC. (London) LTD. 24 \ 28 Oval Road London NWI pp: 703.

Anonymous (1976). International Rice Research Institute (1976) Anuual Report for 1975 Los Bano, Philippines [C.F. Crookston, P.K. and David S. Hill, 1979].

Botros, S.E. (1988). Studies on root and stalk - rot of maize. M. Sc. Thesis Fac. of Agric. Assiut Univ., Egypt.

Bottalica, A. and A. Logrieco (1990). Observations on fusarium disease of maize in Basilicata. II- Effect of some cultural factors. Information fito pathologico, 1988; 38 (2): 55 - 58 Institute di pathologia Vegetal University di Bari, Italy. [C.F. Rev. of plant pathology, 1990 Vol. 69 No. 3.485].

El-Gantiry, S.M.; Dorreiah E. Salem; A.M. Hassanein and M.A. Abd-El-Kader (1993). Effect of intercropping soybean maize on fungal disease and yield. Egypt. J. Appl. Sci. 8 (5): 518 - 527.

Finlay, R.C. (1974). Intercropping soybean with cereals. In: Proceeding of Conference for Scientists of Africa, The Middle East and South Asia. (Soybean production, protection and Utilization). INTSOY Series 77 - 86.

Ismail, A.E.A. (1989). Studies on some disease attacking some rots of some oil crops. M. Sc. Thesis, Fac. of Agric., Zagazig Univ., Egypt.

Mesha, A.M. (1978). Studies on root - rot disease of soybean A.R.E. M. Sc. Thesis, Fac. of Agric., Zagazig Univ., Egypt.

Metwally, A.A. (1973). The study of some companionship between corn and other crops. M. Sc. Thesis, Fac. of Agric., Cairo Univ., Egypt.

Pronczuk, M.; Pronczuk and Massyasz (1992). Pathogenicity of *Fusarium spp.* contributing to the stalk rot of maize in Poland. Mycotoxin Research (1991), 7 [A (supp) part II], 97 - 110. Plant Breeding and Acclimatization Institute Radzikow 05 - 870 Blonia, Poland. [C.F. Rev. of Plant Pathology, 1992, Vol 71 N. 1449].

Sabet, K.A.; A.S. Samra and I.M. Fungary (1972). Mechanism of resistance and susceptibility of infection with late wilt disease of maize. Phytopathology Mediterranean, Vol XI, page 16 - 18.

Samra, A.S.; K.A. Sabet; M. Kamel and M.F. Abd El-Rahim (1971). Further studies on the effect of field conditions and cultural practices on infection with stalk rot complex of maize. Min. Agric., Techn. Bull, No. 2, 1971 p. 86, Egypt.

Singh, J.N.; P.S. Negi and S.K. Tripathi (1973). Study on the intercropping of soybean with maize and Jowar, Indian J. Agron., 18: 75 - 78.

Teich, A.H. (1991). Epidemology of corn (*Zea mays,* L.) ear rot caused by *Fusarium spp.* In: Fusarium: mycotoxin taxonomy and pathogenicity Ed. By Chelkowski, Amsterdam, Netherlands; Elsevier Science Publisher B.V. (1989): 3319 - 328. [c.f. Rev. of Plant Pathology, Vol 70 (1991), No. 4058].

Vakali, N.G. (1985). Mycroparaitic fungi associated with potential stalk - rot pathogens of corn. Phytopathology, 75: 1201 - 1207.

تأثير تحميل الذرة الشامية مع فول الصويا على الإصابة ببعض أمراض المجموع الخضرى الفطرية والخواص المحصولية لكل منهما

عادل الصادق أحمد إسماعيل ، بهاء الكردى أحمد الليثى ، سهام عزت عبد الغفور

معهد بحوث أمراض النباتات ـ مركز البحوث الزراعية ـ الجيزة

إن زيادة إنتاج المحاصيل بإستخدام طرق التحميل من الوسائل الحديثة التى تستخدم لهذا الغرض ، من أجل ذلك تم دراسة عدة نظم لتحميل الذرة الشامية وفول الصويا بغرض تحديد أفضل طريقة للتحميل والتى تكفل تقليل الإصابة بالأمراض كالإصابة بالعفن الوردى والديبلودى والأسود فى الذرة الشامية وكذلك تقليل الإصابة بأعفان القرون والبذور وتبقع الأوراق فى فول الصويا مع زيادة إنتاج المحصولين.

ولقد استعملت ثلاث نظم للتحميل وقد وجد أن التحميل بنظام 2 × 2 أعطت زيادة فى نسبة الإصابة بالفطريات لكلا المحصولين وخصوصا العفن الوردى على الكيزان مع تقليل الصفات الإنتاجية والمحصولية بينما نظام التحميل 2 × 4 كانت أفضل كثيرا من حيث تقليل نسبة وشدة الإصابة على المجموع الخضرى وعلى إصابة الكيزان وبالتالى تحسين الصفات الإنتاجية للمحصولين. كما لوحظ أن الزراعة المنفردة لفول الصويا أعطت أعلا الصفات الإنتاجية بالمقارنة مع نظم التجميل المستعملة بينما الزراعة المنفردة للذرة الشامية أعطت صفات إنتاجية متوسطة مع نسبة إصابة متوسطة بالمقارنة مع نظام التحميل 2 × 4 الذى أعطى أقل نسبة إصابة بالعفن الوردى على الكيزان وأعلى صفات إنتاجية.

Table (5):Effect of intercropping patterns on maize plants characteristics under field conditions in El-Sharkia governorate

Patterns	Length of ear (cm)	No. of rows	No. of grains / ear	Weight of grains / ear (g)	Weight of 100 grains (g)	Diameter of ear (cm)	Weight of cop (g)	Weight of ears /plot (kg)	No. of ear / plot	Area of leaf (cm^2)	Weight of plant (g)	Length of plant (cm)
Sole	20.7	12	40.3	246.7	55.0	4.8	40.0	15.0	63.0	795.0	1600	370
2 x 2	20.9	14	48.5	290.0	45.0	5.7	35.0	18.0	57.0	702.0	1450	380
3 x 3	21.3	10	50.6	286.7	50.0	4.8	66.7	15.0	50.0	832.5	1400	352
2 x 4	21.2	10	48.3	283.3	50.0	4.7	68.3	10.0	33.0	871.0	1650	350
LSD 5%	NS	2.3	3.8	2.7	NS	1.3	8.6	4.1	5.6	24.2	35.2	15.6

Table (6):Effect of intercropping patterns on maize plants characteristics under field conditions in El-Dakahlia governorate

Patterns	Length of ear (cm)	No. of rows	No. of grains / ear	Weight of grains / ear (g)	Weight of 100 grains (g)	Diameter of ear (cm)	Weight of cop (g)	Weight of ears /plot (kg)	No. of ear / plot	Area of leaf (cm^2)	Weight of plant (g)	Length of plant (cm)
Sole	19.5	16	44.0	300.7	57	4.4	45	16.5	56	695	1574	355
2 x 2	20.0	14	45.3	295.0	50	5.2	32	19.4	63	700	1666	380
3 x 3	21.0	12	50.1	280.3	53	4.3	56	15.8	50	864	1432	388
2 x 4	21.0	12	48.3	285.3	54	4.7	66	12.3	36	855	1690	375
LSD 5%	NS	2.4	3.6	7.4	2.6	1.6	6.6	5.4	8.9	28.3	36.7	18.7