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Effect of Maize Planting Dates and Maize Hybrids on The Fall Armyworm *Spodoptera frugiperda* Populations.

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ABSTRACT

The fall armyworm (FAW), *Spodoptera frugiperda* (Smith) is considered one of the most important and most dangerous insect pests that attack maize with great losses in the past few years. With its first appearance in Qotour Center at Gharbia Governorate, northern Egypt during 2021 and 2022 seasons, it was found that the infestation rate is affected by the type of maize hybrid (White hybrid 321, Hybrid yellow 368). The planting dates (mid-May, early June and mid-June) also affected on its population. The mid-May plantation date recorded the lower infestation rate than other planting dates. The highest population density in both hybrids was recorded in the first June and mid-June. Significant differences were found between the two hybrids in the first and mid-June. The average incidence was ranged from 29.7 ± 7.2 to 67.2 ± 9.3 , the highest number recorded on 321 hybrids in mid-June cultivated. At the end of August and the beginning of September, an outbreak of armyworm populations occurred on all plantation dates.

Keywords: Armyworm, Population, Maize

INTRODUCTION

The fall armyworm *Spodoptera frugiperda* (J.E. Smith) is one of the most dangerous insects pests that attacks maize crops and other field crops worldwide (FAO, 2016; CABI, 2017; CABI, 2018; FAO, 2018). FAW is belong to the lepidopteran pests (Lepidoptera: Noctuidae) with two strains, one infested maize and the second infested rice and grasses (Juárez *et al.*, 2012). FAW considers a socioeconomic environmental transboundary insect which causing very high economic yield losses ranged 20 to 100 percent in the world (Abrahams *et al.*, 2017; Day *et al.*, 2017; Mallapur *et al.*, 2018). In Africa, FAW has been recorded in 2016 and by one year spread in 47 countries (Goergen *et al.*, 2016; Tendeng *et al.*, 2019). Without control methods, FAW has the ability to cause maize damage in 12 African countries with range of 20-53% of losses (Day *et al.*, 2017; Frederic Baudrom *et al.*, 2019; De Groote *et al.*, 2020). In Egypt, FAW recorded in upper Egypt in 2019 attacking maize and sorghum (Mohamed *et al.* 2021). Maize and grasses are the main hosts for EAW, it can exceed maize with high infestation reach to 100% (Cruz *et al.*, 1999; Hardke *et al.*, 2015; Balana *et al.*, 2019). Further, FAW is recorded with infestation on 353 plant species (Montezano *et al.*, 2018). The incidence of fall armyworm infestation increases with the increase in the age of the maize plants (Wyckhuys *et al.*, 2006). The infestation by larvae was higher in the first 40 days of planting maize (Jaramillo-Barrios *et al.*, 2019; Suparth *et al.*, 2021). The planting date of maize affect the infestation rate of the FAW (Cruz *et al.*, 2008). Also, the wither factors affected the interbreeding and population of FAW (Clark *et al.* 2007). In this study, the effect of planting dates on the population dynamics, and the effect of the sensitivity of two hybrids of maize, one is white and the other is yellow was investigated during two seasons 2021 and 2022.

MATERIALS AND METHODS

An experiment was conducted on the effect of planting dates for maize crop on population of the fall armyworm in a research farm located in the area of Qotour center, Gharbia Governorate. An area of an acre and a half was allocated for cultivation in three different times (mid-May, first-June and mid-June) with two hybrids of maize, the first is the white hybrid 321 and the second was the yellow hybrid 368. The soil has been prepared for plantation and planted with 5000 maize plants for each hybrid, all agricultural operations were carried out, including cultivation, irrigation and fertilization. Direct counting of the number of larvae present on the plants was conducted and the infection percent was determined based on Urbaneja Garcia 2000.

$$\% \text{ IP} = \frac{\text{Infested plants} \times 100}{\text{total plants}}$$

Data were analyzed using ANOVA. Difference in rate of development were considered significant when $P < 0.05$ and means separated using Duncan's multiple test.

RESULTS AND DISCUSSION

Results

Data in Figure (1) show the population density of the fall armyworm, *S. frugiperda* on the yellow maize hybrid 368 during the three plantation dates of 2021 season. The highest peak was recorded on mid-June plantation during the 4th week of September with 53 larvae/100 plants infestation, Meanwhile the highest population on mid-May plantation recorded on the 4th week of August and represented by 32 larvae /100 plants. On the first-June plantation date, the highest peak recorded on the 2nd week of August with 45 larvae /100 plants.

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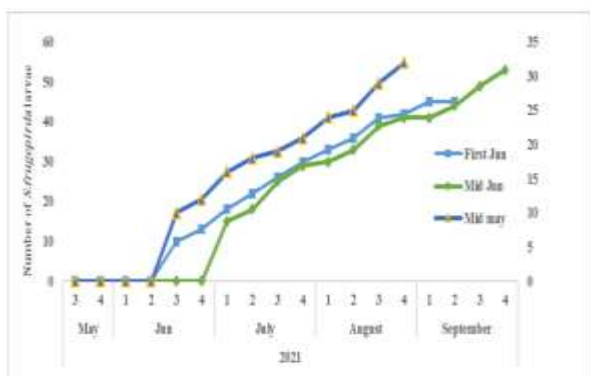


Fig. 1. Population density of the fall armyworm *S. frugiperda* on the yellow maize hybrid 368 during the three plantation dates of 2021 season.

Data in Figure (2) show the population density of the fall armyworm *S. frugiperda* on the yellow maize hybrid 368 during the three plantation dates of 2022 season. The highest peak was recorded during mid-June plantation date on the 4th week of September with 91 larvae/100 plants, Meanwhile the highest population was recorded on the 4th week of August during the mid-May plantation and represented by 45 larvae /100 plants. In respect to first-June plantation date, the highest peak recorded on the 2nd week of August with 71 larvae /100 plants.

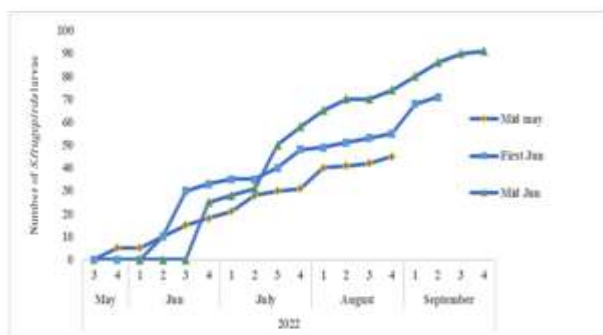


Fig. 2. Population density of the fall armyworm *S. frugiperda* on the yellow maize hybrid 368 during the three plantation dates of 2022 season.

Data in Figure (3) show the population density of the fall armyworm *S. frugiperda* on white maize hybrid 321 during the three plantation dates of 2021 season. The highest Peak were recorded on mid Jun plantation on the 4th week of September with 73larvae/100 plant infestation, Meanwhile the highest population on Mid May recorded on the 4th week of

August by33 larvae /100 plant. On first Jun, the highest peak recorded on 2nd week of August with 43 larvae /100plant.

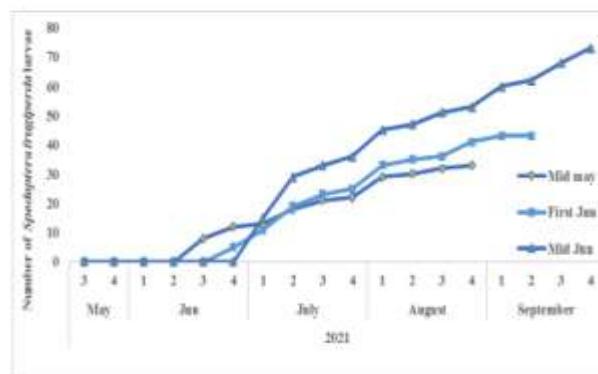


Fig. 3. Population density of the fall armyworm *S. frugiperda* on the white maize hybrid 321 during season 2021 on three plantation dates.

Data in figure (4) show the population density of the fall armyworm *S. frugiperda* on white maize hybrid 321 during the three plantation dates of 2022 season. The highest Peak were recorded on mid Jun plantation on the 4th week of September with 98larvae/100 plant infestation, Meanwhile the highest population on Mid May recorded on the 4th week of August by53 larvae /100 plant. On first Jun, the highest peak recorded on 2nd week of August with 53 larvae /100plant.

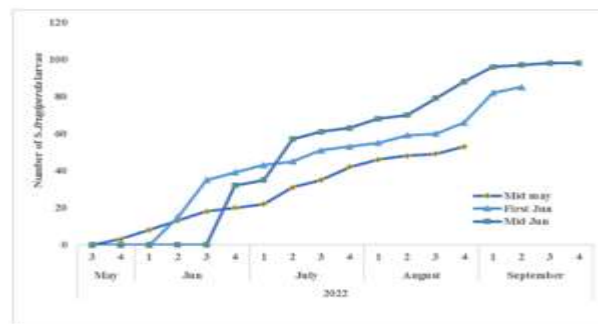


Fig. 4. Population density of the fall armyworm *S. frugiperda* on the white maize hybrid 321 during season 2022 on three plantation dates.

Table 1. Monthly and annually average numbers ±SE of the fall armyworm *S. frugiperda* during the three plantation dates on the yellow maize hydride 386 of 2021 and 2022 maize seasons .

Month	2021			2022		
	Mid May	First Jun	Mid Jun	Mid May	First Jun	Mid Jun
May	0.0±0.0a	0.0±0.0a	0.0±0.0a	2.5±0.5a	0.0±0.0a	0.0±0.0a
June	11.0±2.5a	11.5±2.5a	0.0±0.0a	12.0±2.3b	24.3±3.9a	25.0±3.5a
July	18.5±1.4b	24.0±2.3a	21.7±2.5b	27.5±2.1b	35.5±2.4a	41.7±3.8a
August	27.5±1.9b	38.0±2.1a	35.7±2.2a	42.0±1.46c	52.1±1.6b	69.7±1.9a
September	-----	45.0±1.3b	46.7±1.3b	-----	69.5±2.9a	86.7±2.6a

Means followed by the different letters in rows are significant different at 5% level probability.

Data in Table (2) showed the monthly and annually average numbers of the fall armyworm, *S. frugiperda* on white maize hydride 321 during the three plantation dates. The highest average numbers were recorded on Mid-June

plantation on September in the two seasons with average 65.7±2.4 and 97.5±2.1, also the second season 2022 were higher than season 2021 in all plantation dates.

Table 2. Monthly and annually average numbers ±SE of the fall armyworm *S. frugiperda* on white maize hydride 321 during the different plantation dates of 2021 and 2022 maize seasons.

Month	2021			2022		
	Mid May	First Jun	Mid Jun	Mid May	First Jun	Mid Jun
May	0.0±0.0a	0.0±0.0a	0.0±0.0aa	3.0±0.0a	0.0±0.0a	0.0±0.0a
June	10.±1.6a	5.0±0.0a	0.0±0.0a	14.7±2.3c	29.6±3.5b	32.±0.0a
July	18.5±2.0a	19.5±2.4a	28.2±3.0a	32.5±2.8b	48.0±2.1a	54.0±3.5a
August	31.0±1.3b	36.2±1.8b	49.0±1.9a	49.0±1.7c	60.0±2.1b	76.3±3.0a
September	-	43.0±1.1b	65.7±2.4b	-	83.5±3.1a	97.5±2.1a

Means followed by the different letters in rows are significant different at 5% level probability.

Data in table (3) showed the total average numbers of the fall armyworm, *S. frugiperda* on in the two hydrides during the three plantation dates. The highest total average recorded on Mid Jun plantation during the two seasons with

total average 58.4±9.3 and 67.2±9.5. Also, a significant difference found between mid may plantation and the others plantation dates, also a significant difference found between yellow and white maize on mid may plantation.

Table 3. Annually average numbers ±SE of the fall armyworm *S. frugiperda* on white maize hydride 321 and yellow maize hydride 386 during the different plantation dates of 2021 and 2022 maize seasons .

Maize hydride Year	Plantation date	yellow 386		White 321	
		2021	2022	2021	2022
	Mid May	14.7±5.9a	23.6±6.9b	15.5±6.3a	27.7±7.5b
	First Jun	25.7±7.0a	41.2±7.8b	22.4±7.2a	49.1±8.4b
	Mid Jun	29.7±7.2a	58.4±9.3b	40.8±8.5a	67.2±9.5b

Means followed by the different letters in rows are significant different at 5% level probability.

As conclusions data from table (1 to 3) data indicated that Mid May plantation recorded the lowest population density of the fall armyworm, mid Jun plantation recorded the highest population in both maize hydrides, also the white maize hydride 321 found with higher infestation on Jun plantation than Mid May plantation

Discussion

The fall armyworm found with high monthly and annually averages during the two seasons and can damage the maize production which were agreed with (Cruz et al., 1999, Wyckhuys, 2006, Hardke et al., 2015; Balana et al., 2019 De Groote et al., 2020). The plant age of maize between 20 to 40 day old found with high damages and also the devastating feeding effect became even more severe when maize plant is exposed to prolonged drought which are agreed with (Ayala et al. 2013, Hruska et al. 2019, Niassy et al. 2021, Folake Bosede Anjonin et al. 2022). It can be said that the mid-Jun plantation observed an increase in the average number of FAW, with the entry into the summer months, which are characterized by high temperatures which were agreed with (Cruz et al. 2008; Clark et al. 2007). The early plantation on May found with the lowest infestation which are agreed with Abd El mageed et al. (2022). The Maize hybrid has an effect on the percentage of infection in early seedling, but there are no significant differences between the hybrids in the case of delay in planting.

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تأثير مواعيد زراعة الذرة على أعداد دودة الحشد الخريفية

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معهد بحوث وقاية النبات - مركز البحوث الزراعية - الدقى - جيزة

الملخص

تعتبر دودة الحشد الخريفية احد اهم واخطر الآفات الحشرية الخطيرة التي تهاجم الذرة مع خسائر كبيرة في السنوات القليلة الماضية. مع الظهور الأول لها في مركز قطور بمحافظة الغربية شمال مصر خلال موسمي 2021 و 2022 ، وجد أن معدل الإصابة بالنباتات الذرة يتأثر بنوع هجين الذرة المنزرع (هجين أبيض 321 ، هجين أصفر 368). كما أثرت مواعيد الزراعة (منتصف مايو ، أول يونيو ومنتصف يونيو) على تعدادها . سجل موعد الزراعة في منتصف شهر مايو أقل نسبة إصابة عن مواعيد الزراعة في أول ومنتصف يونيو . سجلت أعلى كثافة سكانية في كلا الهجينين في المزارع الأولى ومنتصف يونيو. تم العثور على اختلافات كبيرة بين الهجينين في الأول ومنتصف يونيو مزرعة. سجلت الإصابة متوسط تراوح بين 7.2 ± 29.7 إلى 9.3 ± 67.2 ، وهو أعلى عدد تم تسجيله على 321 هجيناً في منتصف يونيو المزروع. في نهاية أغسطس وبداية سبتمبر ، حدث اندلاع من أعداد دودة الحشد الخريفية في جميع مواعيد المزارع.