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Bird damage assessment in broad beans (*Vicia faba*) and strawberry (*Fragaria ananassa*) at Qalyubia Governorate, Egypt

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Abstract

Bird damage is a serious problem for the agricultural sector in Egypt, it causes great economic losses by attacking various crops and fruit. Thus, there is an urgent need for accurate damage assessment, which supports any research efforts to reduce that damage. The goals of this study were to measure the use of traditional bird deterrent practices (Scarecrows and reflecting colored plastic stripe) and not use any deterrent practices, on bird damage in broad beans and strawberry fields during the ripening and fruiting stages. The percentage of bird damage in broad bean fields using visual bird deterrent practices and without any deterrent practices (Control) reached 20.51 and 19.31 %, respectively. While in strawberry fields it was 3.14 ± 0.47% in fields using visual bird deterrent practices and 3.74 ± 0.60% in fields without any deterrent practices (Control). Our findings cleared that birds were quickly accustomed to the deterrent practices and used the deterrent equipment as perching sites to attack the crops. It's obvious that these methods didn't affect the harm caused by birds.

Introduction

Birds have different roles in the agricultural ecosystem (Garcia *et al*., 2020). First, a positive role as natural enemies of large numbers of invertebrates and these are a beneficial impact on farmers, but there's a negative role too, as a threat to several agricultural crops (Issa *et al*., 2019 and Garcia *et al*., 2020).

It depredates vegetable, fruit crops and spoils grain, causing damage to several crops during different growth stages (Pejchar *et al.*, 2018), e.g., Broad beans, corn, sorghum, maize, cucumber, peas, groundnut, sunflower, grapes, guava and strawberry are among those crops (Khattab *et al.*, 2002; Attia, 2006; Abbasy *et al*., 2012; Kale *et al*., 2014 and Issa and El-Bakhshawngi, 2018). This leads to economical loss for farmers up to several millions of dollars worth of agricultural crops (Dolbeer *et al*., 1994) .

Broad beans (*Vicia faba* L.) are one of the most strategic legume crops in Egypt, due to their importance as a major part of the Egyptian local dishes (Hegab *et al*., 2014). Egypt is one of the eight main producers of broad beans (150,000 tons that are equivalent to 3.46% of the global production), however, this amount isn't sufficient for consumed and Egypt being imported from abroad (Rawal and Navarro, 2019).

Thus, increasing broad bean production is a main target in the Egyptian agricultural strategy in order to face the demand of the growing population. However, one of the hitches facing this crop is its yield instability which is related to several factors including pests (Darwish and Abdalla, 1997). Birds are one of the main pests for broad beans, they attack pods during the fruiting stage and depredate seeds resulting in losses of approximately 18.65% (Attia, 2006) and reached to 20.40% (Abdel-Gawad *et al.*, 2010).

Strawberry (*Fragaria ananassa* Duchesne) is an important crop in Egypt. Its production increased in recent years and accordingly, Egypt ranked as the fourth largest producer in the world (Essa, 2015). Therefore, strawberry is considered one of the crops that contribute to the national income through exporting (Abd-Elgawad, 2019).

But strawberry fruits have a unique characterization (Deep red color, juicy taste, smooth texture with an aroma) makes them desirable and vulnerable to attack by birds leading to a yield loss of 6.42% (Khattab *et al*., 2002), and may be reached up to 30% (Sharma *et al*., 2019).

Through that paper we highlight the problem of bird damage in broad beans during the ripening stage and strawberries during the fruiting stage with a comparison between using traditional bird deterrent practices (Scarecrows and reflecting colored plastic stripes) and not using any deterrent practices, in an attempt to reduce bird damage on these strategic crops at Qalyubia Governorate, Egypt.

Materials and methods

1. Study sites:

The study was conducted in Qaha and Shibin El Qanater districts, Qalyubia Governorate, Egypt (Figure 1), from September 2020 to May 2021. The study area has histories of grower complaints due to severe bird injuries. Dominant bird species found were house sparrow, *Passer domesticus niloticus* Nicoll and Bonhote (Passeriformes: Passeridae) and hooded crow, *Corvus corone* L. (Passeriformes: Corvidae).

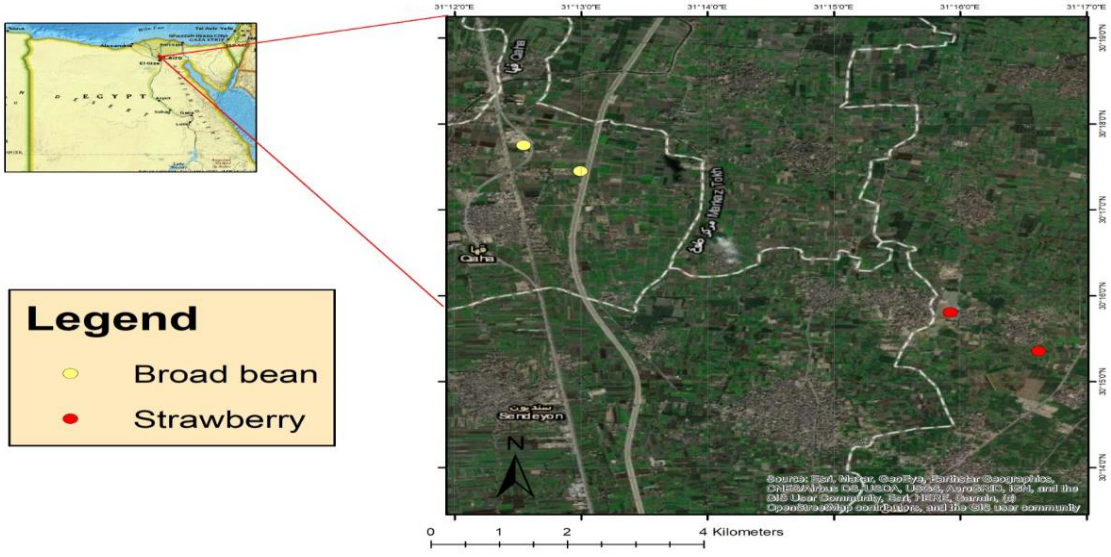

Figure (1): Study sites at Qaha and Shibin El Qanater districts, Qalyubia Governorate, Egypt where fields cultivated with broad beans and strawberry were located.

2. Broad beans fields:

Fields cultivated with broad beans were chosen at Qaha district (30°29087'N, 31°21657'E) and (30°29585'N, 31°20910'E). The selected fields (10 feddans), were divided into two equal divisions to assess bird damage. In the first division we used visual deterrent practices (Traditional scarecrows and reflecting colored plastic stripes) in an attempt to reduce bird damage. The second division was used as a control. Three replicates in both divisions were chosen (1/2 feddan/ each), and were separated by more than 500 m2 (Issa *et al.,* 2019). Ten fixed samples were chosen in each replicate and inspected weekly for 6 weeks. Ten successive plants in each sample were inspected to estimate the degree of bird damage to pods during the ripening stage (After pods emergence and during seed-filling), the damage was calculated for the first week, then the second week by calculating and subtracted from the previous week and so on till the latest week. The degrees of damage were classified into four categories (0, 25, 50, 75 and 100%) depending on the number of seeds existing in the pods. The total percentage of damage was calculated according to Elrawy *et al.* (2021) using the following formula:

$$\text{Damage \%} = (0.0 \times S1 + 0.25 \times S2 + 0.50 \times S3 + 0.75 \times S4 + 1.0 \times S5) / N \times 100$$

Where :

S^1= Number of undamaged pods, S^2= Number of pods with 25% damaged, S^3= Number of pods with 50% damaged, S^4= Number of pods with 75% damaged, S^5= Number of pods with 100% damaged and N= Total number of investigated pods.

3. Strawberry fields:

Two farms cultivated with strawberries were chosen at El Zahweyeen village (30°25595'N, 31°27703'E) and (30°26346'N, 31°26540'E), Shibin El Qanater districts, to determine bird damage to strawberry fruit. Two replicates (4 feddans) in each farm were selected and twenty samples were chosen randomly for investigation. Each sample consists of ten successive plants (Gonthier *et al*., 2019). The number of damaged and undamaged fruits was counted in each plant. The percentage of damage was calculated according to Khattab *et al.* (2002) by the following formula :

%Damage = No. Of damaged fruits / Total No. of examined fruits × 100

4. Data analysis:

Statistical analysis of data was done using CoStat (2005) statistical software. Mean ± standard error (SE) of bird damage was calculated and differences between weeks were analysis at $P \leq 0.05$ level of significance by Duncan (1955).

Results and discussion

1. Broad beans study:

The main bird pest attacking broad beans in our study was the house sparrow. Birds start to attack broad bean pods at the milky stage. It feeds on pods after emergencies and during the seed-filling stage. As a result, hollowed or pecked and eaten seeds within pods were found.

Fields with and without visual bird deterrent practices were inspected weekly, for 6 successive weeks, to determine the percentage of damage. Data illustrated in Table (1) and Photo (1) revealed that, the percentage of damage increased in fields without any bird deterrent practices (Control) during the grain-filling period till the third week, then decreased dramatically during hardness till harvest. In fields with visual bird deterrent practices (Scarecrows and colored plastic stripe) bird damage was 5.01%. Once the deterrent practices were employed the percentage of damage decreased to 3.47%, but quickly birds realized that there was no threat to them, thus attacking broad beans again and using

the deterrent equipment as perching sites, followed that, an increase in damage to reach 6.16%.

Statistical analysis was carried out to compare the damage between weeks and between fields with visual bird deterrent practices and control fields. The comparison showed a highly significant difference at 5% level of significance (P≤0.05) between different weeks. In contrast, there is no significant difference between fields with bird deterrent practices and the control fields during different weeks. There were no significant effects for using visual bird deterrent practices to prevent bird damage in broad beans, t= 0.15, p = 0.44.

Table (1): The percentage of damage at fields with and without visual bird deterrent practices in broad beans.

Week	With visual bird deterrent practices	Without visual bird deterrent practices (Control)	Mean ± S.E.	LSD $_{0.05}$
1st	5.01^{ab}	4.94^{b}	4.96 ± 0.07	1.37
2nd	3.47^{bc}	5.52^{ab}	4.83 ± 0.68	1.93**
3rd	6.16^{a}	6.18^{a}	6.17 ± 0.18	1.91
4th	2.57^{cd}	2.43^{c}	2.81 ± 0.26	3.58
5th	1.54^{cd}	1.05^{d}	1.21 ± 0.24	1.44
6th	0.56^{d}	0.39^{d}	0.45 ± 0.08	1.24
Total	19.31	20.51	20.43	
Mean ± S.E.	3.22 ± 0.86	3.42 ± 1.0007		2.94
LSD $_{0.05}$	2.02**	1.63***		
t-value	0.15141			
p-value	0.44133			

Values in column followed by different letters are significantly at P≤0.05 according to Duncan's multiple range tests.

Photo (1): Damage caused by birds in broad bean pods.

2. Strawberry study:

Strawberry damage occurred during the fruiting stage (Photo 2). Hooded crow and house sparrow are the primary bird pests to strawberry fruits in our study sites. Birds peck strawberry fruits causing wounds to flesh and scrape them .

Strawberry fields were selected to compare applying visual bird deterrent practices (Scarecrows and colored plastic stripes) to deter birds from damaging strawberry fruits with other fields that not using any practices (Control). Fields were inspected for bird damage during the fruiting period for 13 weeks .

The average bird damage in control fields was 3.74 ± 0.60% of fruits and it was almost the same with fields

using visual bird deterrent practices 3.14 ± 0.47%. The highest percentage of damage was recorded during the first week in both control fields and fields with visual bird deterrent practices (7.86 and 5.37%), while the lowest was in the last week with (0.45 and 0.22%), respectively (Table 2).

Statistical analysis indicated a highly significant difference between weeks at ($P \leq 0.05$) in all fields, but there was no significant difference between control fields and fields using visual deterrent practices in the same inspected week, except during the first week which represented highly significant difference.

Table (2): The percentage of damage fruits at fields with and without visual bird deterrent practices in strawberry.

Week	With visual bird deterrent practices	Without visual bird deterrent practices (Control)	Mean ± S.E.	LSD $_{0.05}$
1st	5.37^{a}	7.86^{a}	6.61 ± 1.24	1.15***
2nd	5.25^{ab}	6.25^{b}	5.75 ± 0.5	1.28
3rd	4.54^{abc}	5.90^{c}	5.22 ± 0.68	1.95
4th	4.22b^{cd}	4.52^{cd}	4.37 ± 0.15	2.12
5th	4.18^{bcde}	4.49^{cd}	4.33 ± 0.15	0.66
6th	3.93^{cde}	4.32^{cd}	4.12 ± 0.19	0.99
7th	3.40^{def}	3.89^{d}	3.64 ± 0.24	1.03
8th	3.10^{efg}	3.70^{d}	3.40 ± 0.3	0.65
9th	2.43^{fg}	2.54^{e}	2.48 ± 0.05	0.68
10th	2.29^{g}	2.50^{e}	2.39 ± 0.10	0.55
11th	1.17^{h}	1.23^{f}	1.2 ± 0.03	0.80
12th	0.68^{h}	1.005^{f}	0.84 ± 0.16	0.92
13th	0.22^{h}	0.45^{f}	0.33 ± 0.11	0.77
Total	40.78	48.65	20.43	
Mean ± S.E.	3.14 ± 0.47	3.74 ± 0.60		0.44*
LSD $_{0.05}$	1.08***	1.14***		
t-value	0.726			
p-value	0.237			

Values in column followed by different letters are significantly at P≤0.05 according to Duncan's multiple range tests.

Photo (2): Damage caused by birds in strawberry fruits.

Through our study, it was founded that the total cumulative of bird damage in broad beans during the whole mature stage, reached 20.51% in fields that used visual bird deterrent practices and 19.31 % in fields without any deterrent practices (Control), similar results were found by Abdel-Gawad *et al.* (2010) in Assiut Governorate, Egypt. They found that broad beans average damage was 18.23%, and the house sparrow was the main bird that attacked broad bean pods as soon as they appeared. Attia (2006) reported that the bird damage was higher during the first stages of maturity after pods emergence (18.65%), but soon it decreased rapidly till stopped when seeds become hard .

We also found that there was no significant difference between using visual bird deterrent practices and without using it (Control). In line with this result, Gilsdorf *et al.* (2002) found that traditional visual bird deterrent does not provide sufficient protection .

We also noticed that the birds used the visual deterrent devices as perches to attack broad bean plants from different directions; it was explained by Wang *et al.* (2020) that birds had accustomed to the visual devices in less than 7 days .

When we assessed bird damage in strawberries, we found that average bird damage in control fields was 3.74%, this level of damage was found in other studies. In Egypt, Khattab *et al.* (2002) estimated that bird damage was about 5.57% in strawberry fields. In California USA, Gebhardt *et al.* (2011) estimated that rodent and bird damage to strawberry fruit reached 2.6%. In the same trend, a recent study in California, USA by Gonthier *et al.* (2019) revealed that bird damaged 3.2% of the fruits .

Our study cleared that bird damage in strawberry fruits was higher at the onset of the fruiting stage, this may be because there was no other food found during the first period and afterward the other crops (Such as broad beans, peas, wheat, etc.) are available during that time of the year (From January to May). Also, bird feed on insects found in strawberry fields and thus it's tended to be insect and leaves the crop (Gonthier *et al*., 2019).

Birds are important pests under Egyptian agro-ecosystems. It attacks different economic important crops such as broad beans and strawberries, causing a big amount of damage. The mean percentage of bird damage in strawberry fruit during the study period was 3.74 and 3.14%, while in broad beans it was 3.42 and 3.22% in fields free from any deterrent practices (Control) and fields using visual deterrent practices respectively.

The study demonstrated that using visual deterrent practices such as traditional scarecrows and plastic stripes to minimize bird damage in broad bean pods and strawberry fruits doesn't differ significantly from those without using any visual deterrent practices. Thus, these findings can greatly provide early insight for further research and damage control programs. Also, further studies about bird deterrent practices are needed to determine how birds actually respond and become habituated to visual deterrent practices. In addition, there's an urgent need to study the relationship between growing alternative food as bird temptation and bird deterrent practices.

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