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EFFECT OF WEEDING ON POPULATION OF FALL ARMYWORM (*SPODOPTERA FRUGIPERDA*) AND YIELD OF MAIZE (*ZEA MAYS* L.) IN UMUDIKE, ABIA STATE, NIGERIA

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Abstract

Field experiments were conducted in 2017 and 2018 second planting seasons, at the Research and Teaching Farm of the Faculty of Agriculture, Abia State University,Uturu Umuahia Campus to investigate the effect of weeding on the population of Spodoptera frugiperda and yield of maize. Two Maize varieties, OBA SUPER 2 (yellow seeded) and OBA SUPER 98 (white seeded) were planted as the main plot treatment while four weeding schedules (no weeding, 1, 2, or 3 weedings) were included as the sub-plot treatments. Seeds were sown on ridges 1.0 m apart and 50.0 cm between stands in 5.0 m^2 plots on 5th day of August each year. Data were collected on the number of larvae of fall Armyworm S. frugiperda larvae, damaged plants and grain yield of maize. All data were subjected to analysis of variance (ANOVA) and separation of means done using Least Significant Difference (LSD). During both years, it was found that the weeded plots had significantly ($P<0.05$) lower S. frugiperda population than the non-weeded plots. S.frugiperda population decreased significantly with increase in the number of times sub-plots were weeded. Thus, S.frugiperda population of 7.6 were recorded in the plots weeded thrice in 2017 and 8.3 in the year 2018; with twice weeding it was 10.3 and 10.5 in 2017 and 2018; and for once weeding it was 12.5 and 13.3 in the two years respectively. The non-weeded plot had 13.0 and 16.5 S. frugiperda in the two years respectively. The frequency of weeding was inversely correlated with S. frugiperda population. Grain yields were significantly higher when weeding was done three times compared with weeding twice, once and no weeding respectively. In the two years, the percentage leaf damaged were decreased as the number of weeding increased. There was no significant correlation between S. frugiperda and the grain yields in the two years suggesting that any of the weeding regimes, especially 2-weeding and 3-weeding can be adopted to reduce S.frugiperda infestation in maize with no significant effect on grain yield. In addition , any of the two varieties can be cultivated in the area to achieve good grain yield.

Key words**:** *weeding regimes, fall armyworm, maize yields, Nigeria*

INTRODUCTION

Weeds seriously limit maize production in Nigeria and elsewhere [3]. Weeds interfere with crops by competing for nutrients, water and light; they may also introduce allelochemicals into the habitat they share with crops [3]. The effects may be subtle at first (reduced plant vigour, delayed development or suppression of specific characters) but the ultimate effect is reduction of crop yields [5, 3]. According to [14], the presence of weeds in maize fields reduced crop yields by 40 to 60% depending on the intensity of weed infestation. According to [3] weeds may habour insects and pathogenic organisms harmful to crop plants. The insects at some stage of their life feed on plant root, Stem, leaves and flowers and reduce their vigour or kill them. Weeds can also act as alternate and alternative host plants for disease pathogens and other pests thus making the control of such diseases and pests more difficult [8, 3].However, there is little or no information on the effects of weeding on the population of *S. frugiperda* associated with maize crop in Umudike, a rain forest tropical environment, hence this study was undertaken.

Objectives of the Study

It was the objectives of this study to: (i) determine the population of *S. frugiperda* on maize crops in Umudike; (ii)determine the proportion of damage done by *S. frugiperda*

on maize crops in the area; (iii) determine the effect of weeding regimes on population of *S. frugiperda*; (iv) relate the larvae population of *S. frugiperda*, grain yields and leaf damaged.

MATERIALS AND METHODS

Field experiments were conducted in 2017 and 2018 during the second planting season at the Research and Teaching Farm of the Faculty of Agriculture, Abia State University, Uturu, Umudike Campus to investigate the effect of weeds on fall armyworm *Spodotera frugiperda* of maize. Umudike is located at (Latitude 05^0 $29^{'}$N; longitude 07^0 $33^{'}$E and Altitude of 122m above sea level) in the rain forest belt of Nigeria.

A land area of 320m was ploughed and harrowed. Two varieties of maize OBA SUPER 98 (white seeded) and OBA SUPER 2 (yellow seeded) obtained from Agro input unit of Abia State Ministry of Agriculture, Umuahia were planted. The maize varieties occupied the main plots. Four hoe-weeding regimes (no weeding, 1, 2, and 3 weedings) were used as the sub plot treatments. The first weeding commenced 3- Weeks After Planting (3-WAP) and continued at three weekly intervals according to the number of weedings. Thus, first weeding was carried out at 3 WAP, second at 6-WAP and third at 9-WAP. Each sub plot measured 5m x 5m and was separated by 1.5m paths. The treatments were replicated four times and arranged in a split plot design. Maize was planted in rows on plots spaced 1.0 m between rows and 50.0 cm within rows at two seeds per stand and 3.0 cm deep. The seedlings were thinned to 1per stand at twenty days after seedling emergence. On the same day, a compound fertilizer, N. P.K 15: 15:15 was applied by band at the rate of 75 kg/ha. Ten plants were randomly selected per plot and sampled at each sampling date by direct visual counting using the Tally Counter (A quick counting device). Sampling was done in the morning between 6.30 and 8.30am on each sampling date. Sampling involving counting all the larvae present in each chosen plant. Sampling for larvae started when the crops were 3weeks old after the first weeding.

An area 2x2 ($4m^2$) in the centre of each plot was marked out for determining yield. Plants in the four middle rows were used. Maize cobs were harvested 90 Days After Planting (DAP) and the weight of cobs per plot was determined by harvesting all the plants in each plot and weighing them fresh in kg using an electronic balance. The cobs were later sundried by spreading them out in benches in screen-house for 2-3 weeks. Maize grains were weighed after extraction from the cobs in kilograms and recorded at about 14.0% moisture content. The moisture content was determined by using a moisture meter. The yields were expressed in Kg/ha. Damaged and undamaged leaves in each plot were usually counted. A plant with 25.0% and more of it leaves damaged was considered a damaged plant otherwise it was undamaged [11]. The percentage (%) leaf damaged was calculated and recorded as follows:

$$\% \text{ leaf damaged} = \frac{\text{total number of leaves damaged}}{\text{total number of leaves in sample}} \times 100$$

Data collected were analysed using the analysis of variance (ANOVA), while the Least Significant Difference (LSD) was used to separate the means. Simple regression and correlation analysis was performed to show the relationship between the larvae population, grain yields and leaf damaged.

RESULTS AND DISCUSSIONS

The results on the effect of weeding on the population of *S.frugiperda* larvae and leaves damaged in maize in 2017 and 2018 are presented in Tables 1 and 2.

S. Frugiperda population density on OBA SUPER 98 and OBA SUPER 2 in 2017, was 8.01 and 8.55, while in 2018, it was 10.45 and 10.13, respectively. The weeded plots resulted in significantly ($P<0.05$) lower *S. frugiperda* population than the non-weeded (control) plots. The number of weeding resulted in significant ($p<0.05$) effects on *S. frugiperda* population. Thus, three weeding resulted in significantly lower larvae population of 3.23/ plants in 2017 and 6.35/ plants in the year 2018 compared to 2-and 1-

weeding that had 5.03 and 8.30/plant respectively in 2017 and 8.32 and 10.45/plant respectively in 2018.

Table 1. Effect of weeding on the population of *S.frugiperda* larvae and leaves damaged in maize in 2017

Treatments			
Varieties	larvae/ plant	Grain yield (Kg/ha)	% leaf Damaged
OBA SUPER 98	8.01	1,600.43	25.15
OBA SUPER	8.55	1,800.02	22.16
SE±	0.07	3.65	0.27
LSD (5%)	0.25	10.45	0.73
Weeding			
Control	12.01	510.20	39.05
1-weeding	8.32	954.15	35.18
2-weeding	5.03	2,105.43	36.80
3-weeding	3.23	2,200.12	30.15
SE±	0.28	4.28	1.40
LSD (5%)	0.52	9.58	0.98

Source: Field Experiment, 2017.

The control plants recorded the highest number of *S. frugiperda* per plant 12.01 and 15.60, respectively in 2017 and 2018. The higher *S. Frugiperda* larvae population that was observed in the non-weeded maize plots confirmed report by [1, 12, 13] that weeds acted as reservoir for some insect pest that subsequently infest crop plants.

Table 2. Effect of weeding on the population of *S.frugiperda* larvae and leaves damaged in maize in 2018

Treatments			
Varieties	larvae/ plant	Grain yield (Kg/ha)	% leaf damaged
OBA SUPER 98	10.45	475.15	23.43
OBA SUPER	10.13	590.50	21.75
SE±	0.15	1.62	0.17
LSD (5%)	0.38	4.98	0.63
Weeding			
Control	15.60	4,950.17	38.81
1-weeding	10.45	905.14	20.25
2-weeding	8.30	1,545.13	24.13
3-weeding	6.35	1,834.75	15.43
SE±	0.23	4.25	0.24
LSD (5%)	0.59	9.74	0.57

Source: Field Experiment, 2018,

Grain yields of maize (Table 2) were significantly ($P<0.05$) higher in the weeded than the non-weeded plots. Significant differences were also obtained among the weeded plots. The highest grain yields were obtained from the 3-weeding plots, which gave 2,200.12 kg/ha in 2017 and 1,834.75 kg/ha in 2018, while 2-weedings gave 2,105.43 kg/ha and 1,545.13 kg/ha in 2017 and 2018, respectively. The 1-weeding plot gave 954.15 and 905.14 kg/ha in the corresponding years. The lower grain yield observed on these plots confirms report by [5, 15, 9] that the ultimate effect of weed interference on crop plant is reduction of crop yield.

Similarly, [14] reported that uncontrolled weed growth during period of 10 and 30 days after crop emergence reduced maize yield by 40 to 60% [7] reported that caterpillar of *S.frugiperda* appear to be much more damaging to maize in the west and central Africa than most other *Spodoptera* species. Infestations during the mid-to late-whorl stage of maize development caused yield losses of 15-73% when 55-100% of the plants were infested with *S.frugiperda* [6, 7].

The percentage leaf damaged was significantly ($P<0.05$) lower on OBA SUPER2 than in OBA SUPER 98. The weeded plots resulted in significantly lower percentage damaged leaves than non-weeded plots. The relationship between *S.frugiperda* population, grain yields and damaged leaves is presented in Table 3.

There was an indication of high correlation (Table 3) between *S.frugiperda* and grain yield ($r=-0.931$ and -0.935) in 2017 and 2018, respectively. The leaves damaged decreased as the number of weeding increased. Thus, 30.15 and 15.43% damaged leaves was obtained in the 3-weeding; 35.18 and 24.13% in the 2- weeding plots while 36.8% and 26.25% were obtained in the 1- weeding plots in 2017 and 2018, respectively.

The highest percentage leaf damaged was obtained in the control plot 39.05 and 38.81 in 2017 and 2018, respectively.

Table 3. Regression and Correlation analysis showing the relationship between the *S.frugiperda* population, grain yields and damaged leaves

Variables	Regression equation	R^2	r
2017			
S.frugiperda population and grain yield	Y=4.176-0.00405X	0.903	-0.931
S.frugiperda and damaged leaves	Y=-14.936+1.026X	0.951	0.968
2018			
S.frugiperda population and grain yield	Y=8.117-0.000871X	0.850	-0.954
S.frugiperda and damaged leaves	Y=-3.0612+6.693X	0.842	0.925

Source: Field Experimets 2017 & 2018.

The percentage leaf damaged which was observed to decrease as the *S.frugiperda* population decreases in weeding plots further explained the activities of some insect pests; for example, *S.frugiperda* larvae [7] in causing damage to the leaves and resulting in the yield losses: the larvae then migrate to adjacent area in true armyworm fashion. These results are similar to those of [4], that reducing the weeding interval which directly increase the number of weedings, enhanced grain yields while [2] reported that the two weedings at three and six weeks after planting are necessary for most legumes.

The higher *S. Frugiperda* larvae population that was observed in the non-weeded maize plots confirmed report by [1, 12, 13]; that weeds acted as reservoir for some insect pest that subsequently infest crop plant. The lower grain yield observed on these plots confirm report by [5, 15, 9] that the ultimate effect of weed interference on crop plant is reduction of crop yield.

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CONCLUSIONS

There was no difference between the two varieties in the terms of their response to the damage caused by the larvae. The three weeding regimes, 1-weeding, 2-weeding, and three-weeding were effective against the larvae of *S.frugiperda.* Therefore, any of the weeding regimes especially 2-weeding and 3-weeding can be adopted to reduce *S. frugiperda* infestation in maize depending on their cost- benefit analysis. Similarly, any of the two varieties of maize can be cultivated in the area for a good grain yield.

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