EFFECT OF INTERCROPPING ON THE INFESTATION OF FRUIT BORER *(Helicoverpa armigera)* AND YIELD OF TOMATO

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Abstract
Tomato (Solanum lyccopersicon), a favourite condiment in Nigeria and a good source of vitamin C, lycopene and carotenoid is prone to attack of fruit borer which can cause about 50% losses of its yield. The health risk and development of resistance associated to synthetic insecticides necessitates the manipulation of some of agronomic practices to check the incidence and damage caused by this insect on tomato fruit. This study was conducted using randomized complete block design with four treatments and three replications to investigate the effect of intercropping tomato with maize, cowpea and soya beans on the incidence and damage caused by fruit borer on tomato plant. The results showed significant lower larval holes/plant, number of damaged fruits/plant, higher fruit weight and higher fruit yield ($P<0.05$) in all the treatments where tomato was intercropped with maize, cowpea and soya beans when compared with sole crop tomato. It is thus recommended that intercropping should be encouraged in planting of tomato, and interplanting tomato with maize, cowpea and soya beans should be employed to check the damage caused by fruit borer on tomato plant and to increase total yield of tomato.

Introduction

Tomato is a popular and nutritive vegetable crop ranking next to potato in world's vegetable production. It is an important source of minerals and antioxidants such as carotenoids, lycopene, vitamin C, E and phenolic compounds with a key role in human nutrition to prevent certain cancer and cardiovascular diseases (Adalid, Rosello & Nuez, 2004.). Tomatoes are consumed in a number of ways including sun dried tomatoes, tomato sauce, tomato juice, tomato soup, tomato ketchup, and fresh as salad.

In the tropics, particularly Nigeria, many insect pests are associated directly with tomato damage and yield losses, while others are important vectors of diseases (Anonymous, 1986; Umeh & Oyedun, 1995). Tomato crop is prone to many insect pest infestations particularly the devastating fruit borer (Helicoverpa armigera) which is a serious pest of tomato in both rainy and dry season in Nigeria and other tomato growing countries (Trenbath, 1993; Pino, De-Los, Bertoh M & Espinosa, 1994; Degri &Mailafiya, 2014).

Intercropping is the growing of two or more crops in proximity in the same field during a growing season to promote interactions between them, reduce pests and diseases incidence, increase biodiversity, crop stability, risk spreading, food security, effective use of labour, increased crop

productivity and erosion control (Gomez, 1990; Trenbath, 1993). Intercropping has some suppressing effects on most of the insect pests through the changed cropping canopy and resultant change in micro-climate (Jayaraj, 2002; Ijoyah, 2012; Degri & Samalia, 2014). Intercropping of tomato with other crops of different canopy significantly influence tomato insect pest population's density and reduces fruit damage than sole tomato crops (Pino De-los, Bertoh & Espiniosa,1994; Sharma & Tiwari, 1996).

Intercropping creates barrier in the spread of insect infestation, it influences the migration of insect pests in such a way that crop colonization is delayed and causes reduction in population level of the insect pest in intercropped crops than sole crops (Altileri & Liebman, 1994;Hugar & Palled, 2008). Sharma and Tiwari (1996) created a successful barrier using intercropping to check incidence of tomato fruit borers.

Intercropping is a convenient method for disease management in crop production. It has advantages over single crops which more often requires chemical control. While single crops provide pathogens with a continous substrate over time and space, intercropping promotes biological diversity, improves the use of natural resources, diminishes the risk of crop losses and provides barriers to the attack of insects and diseases (Francis, 1990).

The use of insecticides has been the major control measures for tomato fruit borer in Nigeria (Degri &Samalia, 2014). Since tomato fruit may be eaten raw in salad, the health and environmental hazard associated with chemical insecticides should be avoided. Hence, there is a need to consider alternative control measures that will be effective, affordable, adoptable, environment friendly and safe to the users.

Statements of the problem

Tomato is an important source of vitamins in human diet, however, fruit borer causes over 50% losses in yield of tomato. The chemical insecticides available for control of fruit borer are not environment friendly and not accessible to peasant farmers. Thus constituting problems to health and economic development of the society.

Purpose of the study

1. The purpose of the study is to investigate the effect of intercropping on the infestation and damage caused by fruit borer on tomato.
2. To investigate effect of intercropping on yield of tomato.

Hypotheses

1. There is no significant difference on the damage caused on tomato between intercropped and sole tomato.
2. There is no significant difference in yield of tomato between intercropped and sole tomato

Significance of the study

The results of the study would provide vital information for farmers on the use of intercropping to reduce losses caused by infestation of fruit borer on tomato.

The outcome of the study would also reduce health hazard associated with indiscriminate use of chemical insecticides to control fruit borer of tomato.

Methodology

The treatments comprised of sole tomato, tomato intercropped with maize,

tomato intercropped with cowpea, tomato intercropped with soya beans. Tomato seedlings were raised at the nursery at the experimental field of National Horticultural Research Institute (NIHORT), Ibadan. Tomato seedlings were transplanted at 60 x 60 cm spacing in a field of 4.0 m x 3.0 m size with 1.0 m inter-space for maize, cowpea and soyabean. Maize, cowpea and soyabeans were planted at the same time and on the same day with tomato seedlings at inter row spacing of 25 cm. Each of the intercropped plant was planted on top of the ridges in between tomato rows at the seed rate of 2 seeds per stand and 3 cm depth. The plots were weeded and NPK 15:15:15 fertilizer applied twice to each plot at 4 and 7 weeks after planting and transplanting for both the sole and intercrops.

Data taken for tomato included the incidence of fruit borer larval holes at 7 days interval from appearance of fruit to crop maturity by counting number of larval holes per 5 tagged plants in each plot. The damaged and undamaged fruits were harvested, sorted and weighed separately from each plot. Damaged fruits caused by fruit borer were characterized by tunnels or holes inside the fruit and entrance or exit holes on the fruit. Undamaged fruits were recognized on the basis of the absence of the fruit borer tunnels, entrance or exit holes (Degri & Samalia, 2014). Harvested fruits were weighed and recorded separately (damaged and undamaged fruits from each plot).Number of holes on each fruit were recorded per plant.

The data collected in respect of fruit borer count, fruit damaged and undamaged, fruit weight and fruit yield were subjected to analysis of variance (ANOVA). Fisher's least significant difference (LSD) was used to separate the treatment means (Degri &Samalia, 2014).

Results

Table 1:
Number of Larval Holes, Damaged and Undamaged Fruits per Plant of Tomato Intercropped With Maize, Cowpea and Soyabeans

Crop	No. of holes/tagged plant	No. of damaged fruits/plant	No. of undamaged fruits/plant
Sole tomato	43.5a	42.5a	6.2c
Tomato + Maize	5.0c	8.0c	46.5a
Tomato + Cowpea	13.0b	15.0b	34.8b
Tomato + Soya beans	14.5b	12.0b	32.6b

Meanswith same letter along the column are not significantly different (P<0.05)

Table 2:
Fruit Weight and Yield per ha of Tomato Plants Intercropped with Maize, Cowpea and Soyabeans

Crop	Fruit weight (g)	Fruit yield (t/ha)
Sole tomato	15.5c	17.2c
Tomato + Maize	25.5a	23.2a
Tomato + Cowpea	22.5b	21.5 b
Tomato + Soya beans	21.8b	20.6b

Means with same letter along the column are not significantly different (P<0.05)

The results showed that significant lower larval holes per plant were obtained in the intercropped treatments (Tomato/maize, Tomato/cowpea and Tomato/soyabeans) compared with sole tomato had highest number of larval holes of 43.5, while lower number of larval holes were recorded in tomato intercropped with maize (5.0), intercropped with cowpea (13.0) and intercropped with soya bean (14.5) . The results also showed that highest number of damaged fruits per plant were obtained in sole tomato (42.5) compared with intercropped counterparts (Table 1). Significantly lower damaged fruits were recorded in tomato intercropped with maize (8.0), cowpea (15.0) and ntercropped soya beans (12.0).

Lowest damaged fruits were recorded in tomato intercropped with maize (8.0). However, maximum number of undamaged fruits was recorded from tomato intercropped with maize (46.5), followed by tomato intercropped with cowpea (34.8) and tomato intercropped with soya beans (32.6), while the lowest number of undamaged fruits (6.2) was recorded in sole tomato. The value obtained in sole tomato was significantly lower to those of ntercropped treatments.Tomato fruit weight and fruit yield were significantly influenced by all the crops with which tomato was intercropped (Table 2).

Maximum fruit weight (25.5g) and fruit yield (23.2 t/ha) were recorded in tomato intercropped with maize, while the minimum fruit weight (15.5g) and fruit yield (17.2t/ha) were obtained in sole tomato. Fruit weight of 22.5g and fruit yield of 23.2t/ha were obtained in tomato/ cowpea intercrop, fruit weight of 21.8g and fruit yield of 23.2t/ha for tomato/soya beans intercrop, The values were also significantly higher than the fruit weight of 15.5g and fruit yield of 17.2t/ha in sole tomato .

Discussion of Findings

Intercropping tomato with maize, cowpea and soyabeans significantly reduced the infestation of tomato fruit borer (Helicoverpa armigera). The three intercropped plants (maize, cowpea and soya bean) reduced the number of larval holes per plant, number of damaged fruits per plant and significantly increased tomato

fruit weight and fruit yield. The reduction in the incidence of fruit borer recorded in the intercropped crops is in accordance with the report of Ram and Singh, (2010); Degris et al. (2014); Degris and Samalia, (2014) who reported that intercropping tomato and maize has a potential of reducing tomato fruit borer incidence.

Significantly higher number of damaged fruit/plant, larval holes/plant, lower fruit weight and fruit yield recorded in sole tomato showed that monocropping encourages pest incidence build up and damage when compared to intercropping. The higher number of undamaged fruits/plant, higher fruit weight and fruit yield recorded in maize, cowpea and soya beans intercropped with tomato showed tomato fruit borer to be a specific pest of tomato which does not spread easily through the crops used an intercrops as it spreads in the sole tomato crop (Degris & Samalia, (2014). The reduction in infestation in the intercropped plants observed may be as a result of distance between plant of the same species and diversity of crop grown.

Conclusion

There was a great reduction in the damage caused by fruit borer on intercropped tomato, which was associated with significant increase in fruit yield of intercropped tomato, hence it is concluded that Intercropping of tomato with maize, cowpea and soya beans with tomato plant is effective in checking the infestation and damage of fruit borer (Helicoverpa armigera) on tomato.

Recommendations

- It is recommended that interplanting of tomato should be encouraged to reduce build up of population of pest and incidence of fruit borers.
- It is also recommended that intercropping tomato with maize, cowpea and soya beans should employed in order to increase the total yield of tomato

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