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PRELIMINARY STUDIES ON INCIDENCE OF INSECT PESTS ON OKRA (*ABELMOSCHUS ESCULENTUS* (L.) MOENCH) IN THAILAND

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Abstract

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Among the insect pests that cause economic damage on okra, *Aphis gossypii* Glover, *Thrips palmi* Karny, *Amrasca biguttula* Ischida, *Bemisia tabaci* Genn. and *Xanthodes transversa* Guenee, have been observed on the cultivated plot of okra during the June to October 2009 and 2010 season. The most average occurrence at 8.99±1.14, 64.42±4.64, 52.44±3.99, 14.07±1.64 and 1.43±0.64 insects/plant of *A. gossypii* Glover, *T. palmi* Karny, *A. biguttula* Ischida, *B. tabaci* Genn. and *X. transversa* Guenee were observed respectively during the 2009 season, (June to October), while the most average occurrence at 9.81±1.12, 66.55±5.03, 54.44±4.51, 17.10±1.24 and 1.74±0.75 of *A. gossypii* Glover, *T. palmi* Karny, *A. biguttula* Ischida, *B. tabaci* Genn. and *X. transversa* Guenee were observed respectively during the 2010 season, (June to October). Effects of agroclimatic factors on the growth of insect pests were also observed during the duration of the study. Temperature, relative humidity and rainfall showed direct effect on the population trend of all insect pests.

Key words: okra (*Abelmoschus esculentus* (L.) Moench), insect pest, population, season

Introduction

Okra (*Abelmoschus esculentus* (L.) Moench, Malvaceae), the most popularly vegetable crop in Asia and Africa, is thought to be native crop extending from Ethiopia to the Sudan. In the early of its history and distribution are not known, but it was apparently introduced to Egypt in the seventh century. Okra then was carried through North Africa and the areas bordering the Mediterranean and eastward (Ahmed, 2000). The economic importance of okra cannot be overemphasized. Okra is considered a prized vegetable due to its high nutrient value (Dabire-Binso et al., 2009). Okra contains carbohydrate, proteins and vitamin C in large quantities[Water (%) 90, Energy (kcal) 38, Protein(g) 2.0, Fat (g) 0.1, Carbohydrate (g) 7.6, Fiber (g) 0.9, Ca (mg) 81, P (mg) 63, Fe (mg) 0.8, Na (mg) 8, K (mg) 303, Vitamin A (IU) 660, Thiamine (mg) 0.20, Riboflavin (mg) 0.06, Niacin (mg) 1.00, Ascorbic acid (mg) 21.1 and Vitamin B6 (mg) 0.22] (Adeboye and Oputa, 1996). For consumption, young immature fruits are important fresh fruit –vegetable that can be consumed in different forms. They could be boiled, fried or cooked. In Asia, okra is usually boiled in water resulting in slimy soups and sauces, which are relished. The fruits also serve as soup thickeners (Moekchantuk and Kumar, 2004). The leaves buds and flowers are also edible. Okra seed could be dried. The dried seed is a nutritious material that can be used to prepare vegetable curds, or roasted and ground to be used as coffee additive or substitute. Okra leaves are considered good cattle feed, but this is seldom compatible with the primary use of the plant. Okra mucilage is suitable for medicinal and industrial applications. It has medically found application as a plasma replacement or blood volume expander. Industrially, okra mucilage is usually used in to glace certain papers and useful in confectionery among

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other uses (Markose and Peter, 1990). In Thailand have annually increased in a large land area for the cultivation of okra particularly those areas in the central, south and northeastern regions. Nevertheless, growers in all regions of the country have come across with many problems (Mehmook et al., 2001). Cotton aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae), cotton thrips, *Thrips palmi* Karny (Thysanoptera: Thripidae), cotton leafhopper, *Amrasca biguttula* Ischida (Homoptera: Cicadellidae), cotton white fly, *Bemisia tabaci* Genn. (Hornoptera: Aleyrodidae) and transverse moth, *Xanthodes transeversa* Guenee (Chloephorinae: Nolidae) have been listed as major pests of okra production in Thailand (Petlamul et al., 2009; Ek-Amnuay, 2010). These pests infest leaves, stems, branches, flowers and pods (Sharma et al., 2010). The population of these pests has been built up due to monocropping in recent years because of an increased in demand for *Abelmoschus esculentus* in commercial quantity. The aim of the present investigation is to evaluate the effect of insect pest's infestation on okra.

Materials and Methods

Plant material

Fifteen accessions of okra were collected from somewhere in Thailand and other countries (Table 1). All accessions of okra were sown under the field trial conditions at the Department of Plant Sciences, Faculty of Technology and Community Development Thaksin University in two seasons (first season June and October 2009, second season June and October 2010). Prior work before planting was carried out by thoroughly ploughing the soil area and left it to rest for one week. Afterwards, the plot was size 5 x 2 m (10 m^2) three seeds of okra were dropped in each hole. Each accession was sown in four replications. Plant to plant and row-to-row spacing was maintained at 75 cm and 75 cm, respectively. The rows were planted in pair with 12 holes in each replication. Randomized Complete Block Design (RCBD) was planned. Seven days after planting, they were separated and only one plant was left in the hole. The full rate of NPK 15-15-15 (650 $kg \cdot ha^{-1}$) and the full rate of organic based fertilizers (manure) were applied at 12,500 $T \cdot ha^{-1}$ and it was done 2 times. The first time, the organic based fertilizer would be put in the bottom of the hole after the soil had already been prepared. The second time, the organic based fertilizer would be filled around the hole again, about 28 days after planting. The conventional agronomic practices were followed to keep the crop in good condition.

Data records

Counting on adult insect pests population of *A. gossypii* Glover, *T. palmi* Karny, *A. biguttula* Ischida, *B. tabaci* Genn and *X. transversa* were done 4, 6, 8 and

Table 1
Sources and original sources of okra

No.	Accessions	Sources	Original sources
1	KN – OYV – 01	Phichit Horticulture Research Center	India
2	KN – OYV – 02	Phichit Horticulture Research Center	India
3	KN – OYV – 03	Phichit Horticulture Research Center	India
4	KN – OYV – 04	Phichit Horticulture Research Center	India
5	KN – OYV – 11	Phichit Horticulture Research Center	India
6	KN – OYV – 13	Phichit Horticulture Research Center	India
7	KN – OYV – 14	Phichit Horticulture Research Center	India
8	KN – OYV – 16	Phichit Horticulture Research Center	India
9	KN – OYV – 25	Phichit Horticulture Research Center	India
10	Lucky file 473	Bangkok Province	Japan
11	NO 71	Phichit Horticulture Research Center	India
12	OP (control accession)	Phatthalung Province	Thailand
13	PC 52S5	Phichit Horticulture Research Center	Thailand
14	PJ. 03	Phichit Horticulture Research Center	Thailand
15	TVRC 064	Bangkok Province	Thailand

10 weeks after planting on the cultivated plot of the okra. It was usually done between 6.00 am and 10.00 am because these insects were usually easy found on the surface of the leaves for feeding. The numbers of adult pests caught on each occasion as well as their species identity to be recorded. Insects were caught by hand picking since they were only capable of exhibiting limited flight within the circle of their environment. Analysis of pest population was carried out in relation to the effect of climatic parameters such as temperature, relative humidity and rainfall. The numbers of insects at every two weeks was plotted to determine the change in population structure of each species over time.

Data analysis

SAS software was used for data analysis. ANOVA was performed for each of the parameters and separation of the means was done using the Least Significant Difference (LSD) test at 5% and 1% significant level.

Results

In the present study of the average of *A. gossypii*, *T. palmi*, *A. biguttula* , *B. tabaci* and *X. transversa* of okra between 4, 6, 8 and 10 weeks after planting in 2009, it was found that the number of insects were significantly different in all types. *A. gossypii* had the highest number on KN – OYV – 01 with the level of impairment at 8.99±1.14 insects/plant. Next were OP, TVRC 064, KN – OYV – 04, KN – OYV – 16, PC 52S5, KN – OYV – 25, KN – OYV – 13, KN – OYV – 14, KN – OYV – 02, NO 71, KN – OYV – 11, PJ 03, KN – OYV – 03 and Lucky file 473 with the level of impairment at 8.98±1.01, 8.66±1.09, 8.55±1.08, 8.47±1.11, 8.41±0.89, 8.23±1.14, 7.99±1.09, 7.84±1.09, 7.67±1.21, 7.56±0.98, 7.35±1.03, 7.11±1.06, 6.47±1.19 and 6.15±1.08 insects/plant respectively. The number of *T. palmi*, it was found that KN – OYV – 02 had the highest number of *T. palmi* at 64.42±4.64 insects/plant. Next were accession of NO 71, KN – OYV – 11, PC 52S5, Lucky file 473, KN – OYV – 13, TVRC 064, PJ. 03, KN – OYV – 03, KN – OYV – 04, KN – OYV – 16, KN – OYV – 25, KN – OYV – 01, OP and KN – OYV – 14 with the number of *T. palmi* at 63.12±4.23, 60.77±4.21, 58.41±4.26, 57.63±4.29, 56.97±5.03, 55.74±3.99, 54.52±5.13, 53.98±4.35, 52.17±4.23, 50.03 ±4.54, 49.53±4.21, 49.41±5.02, 44.53±4.22 and 43.85±4.98 insects/plant, respectively. KN – OYV – 02 had the highest average number of *A. biguttula* and *B. tabaci* (52.44±3.99 and 14.07±1.64 insects/plant, respectively), whereas the minimum infestation of *A. biguttula* and *B. tabaci* were recorded on PC 52S5 and KN – OYV – 03 at 21.25±3.75 and 6.43 ± 1.57 insects/plant, respectively. The highest number of *X. transversa* was observed on OP at 1.43±0.64 insects/plants (Table 2).

The average insect pests in 2010 (4, 6, 8 and 10 weeks after germination) were found that the levels of impairment of insects were significantly different in all types as in 2009. *A. gossypii* had the highest average level in KN – OYV – 01 with the level of 9.81±1.12 insects/plant. OP, TVRC 064, KN – OYV – 04, KN – OYV – 16, PC 52S5, KN – OYV – 13, KN – OYV – 14, KN – OYV – 02, NO 71, KN – OYV – 11, KN – OYV – 25, PJ 03, KN – OYV – 03 and Lucky file 473 were level of impairment at 9.31±0.98, 8.68±0.85, 8.56±1.03, 8.50±0.92, 8.43±0.99, 8.00±1.07, 7.87±1.07, 7.68±1.01, 7.62±0.76, 7.37±1.13, 7.25±0.83, 7.12±1.24, 6.50±0.92 and 6.18±0.77 insects/ plant, respectively. The average level of *T. palmi*, it was found that KN – OYV – 02 had the highest level of impairment at 66.55±5.03 insects/plant. Next were accession NO 71, KN – OYV – 11, PC 52S5, Lucky file 473, KN – OYV – 13, TVRC 064, PJ. 03, KN – OYV – 03, KN – OYV – 04, KN – OYV – 16, KN – OYV – 25, KN – OYV – 01, OP and KN – OYV – 14 with the average level at of *T. palmi* impairment at 65.33±5.75, 62.89±4.29, 60.55±4.54, 59.77±7.35, 59.11±4.83, 57.88±4.89, 56.66±5.14, 56.11±5.12, 54.33±5.01, 52.22±3.98, 51.67±4.04, 51.55±4.23, 46.67±2.33 and 45.99±3.78 insects/plant, respectively. KN – OYV – 02 had the highest level of *A. biguttula* and *B. tabaci* at 54.44±4.51 and 17.10±24 insects/plant, respectively. PC 52S5 and KN – OYV – 03 had the lowest *A. biguttula* and *B. tabaci* at 23.26±2.75 and 9.44 ± 1.23 insects/ plant respectively. *X. transversa* was found that the highest impairment level to be obtained from OP at 1.74±0.75 insects/plant, while other accessions were average of *X. transversa* between 0.66±0.26 and 1.50±0.75 insects/plant (Table 3).

The present study quantitatively compares the influence of temperature and the level of relative humidity and raining on development times of five insect types

Table 2
Mean abundance of insect pests in 2009

Accessions	Number of insects/plant in 2009				
	A. gossypii	*T. tabaci*	*A. biguttula*	*B. tabaci*	*X. transversa*
KN - OYV – 01	8.99±1.14	49.41±5.02	37.68±4.03	11.99±2.01	0.52±0.21
KN – OYV – 02	7.67±1.21	64.42±4.64	52.44±3.99	14.07±1.64	0.93±0.09
KN – OYV – 03	6.47±1.19	53.98±4.35	43.93±3.97	6.43±1.57	0.53±0.06
KN – OYV – 04	8.55±1.08	52.17±4.23	40.69±4.03	9.08±1.66	0.31±0.15
KN – OYV – 11	7.35±1.03	60.77±4.21	49.13±4.23	12.52±1.65	0.96±0.09
KN – OYV – 13	7.99±1.09	56.97±5.03	44.91±2.99	13.51±0.98	1.19±0.21
KN – OYV – 14	7.84±1.09	43.85±4.98	42.37±3.65	12.42±1.35	1.19±0.21
KN – OYV – 16	8.47±1.11	50.03±4.54	46.58±3.54	10.15±1.79	0.82±0.12
KN – OYV – 25	8.23±1.14	49.53±4.21	41.24±4.11	12.42±1.91	0.35±0.06
Lukcy file 473	6.15±1.08	57.63±4.29	33.09±4.09	13.21±1.79	0.92±0.21
NO 71	7.56±0.98	63.12±4.23	40.67±4.02	13.42±1.39	0.77±0.27
OP	8.98±1.01	44.53±4.22	42.81±3.99	11.33±1.86	1.43±0.64
PC 52S5	8.41±0.89	58.41±4.26	21.25±3.75	7.97±1.53	0.76±0.45
PJ. 03	7.11±1.06	54.52±5.13	35.21±4.11	10.23±1.78	0.52±0.15
TVRC 064	8.66±1.09	55.74±3.99	42.55±3.65	13.98±1.45	1.02±0.50
$LSD_{0.05}$	1.07	12.43	11.51	1.02	0.39
$LSD_{0.01}$	2.26	16.33	15.74	3.66	0.65
CV %	7.46	8.85	6.21	4.76	8.05

Table 3
Mean abundance of insect pests in 2010

Accessions	Number of insects/plant in 2010				
	A. gossypii	*T. tabaci*	*A. biguttula*	*B. tabaci*	*X. transversa*
KN - OYV – 01	9.81±1.12	51.55±4.23	39.66±3.98	14.99±1.65	0.83±0.25
KN – OYV – 02	7.68±1.01	66.55±5.03	54.44±4.51	17.10±1.24	1.25±0.89
KN – OYV – 03	6.50±0.92	56.11±5.12	45.89±4.12	9.44±1.23	0.83±0.55
KN – OYV – 04	8.56±1.03	54.33±5.01	42.66±3.38	12.11±2.01	0.67±0.65
KN – OYV – 11	7.37±1.13	62.89±4.29	51.11±4.05	15.55±2.35	1.25±0.54
KN – OYV – 13	8.00±1.07	59.11±4.83	46.89±3.56	16.55±3.24	1.50±0.55
KN – OYV – 14	7.87±1.07	45.99±3.78	44.33±3.79	15.44±3.04	1.50±0.75
KN – OYV – 16	8.50±0.92	52.22±3.98	48.55±3.99	13.21±3.06	1.16±0.44
KN – OYV – 25	7.25±0.83	51.67±4.04	43.22±3.12	15.44±2.25	0.66±0.26
Lukcy file 473	6.18±0.77	59.77±7.35	35.00±2.78	16.21±3.23	1.24±0.75
NO 71	7.62±0.76	65.33±5.75	42.66±3.91	16.44±3.38	1.08±0.53
OP	9.31±0.98	46.67±2.33	44.78±3.34	14.33±2.18	1.74±0.75
PC 52S5	8.43±0.99	60.55±4.54	23.26±2.75	10.99±1.01	1.08±0.62
PJ. 03	7.12±1.24	56.66±5.14	37.22±2.73	13.22±2.21	0.83±0.68
TVRC 064	8.68±0.85	57.88±4.89	44.55±1.99	16.99±2.15	1.33±0.48
$LSD_{0.05}$	1,10	14,57	13,48	4,03	0,71
$LSD_{0.01}$	2,25	18,48	17,76	6,69	0,98
CV %	7,47	11,00	8,18	6,79	8,38

during the experimental period from June to October in 2009 and 2010, it was found that in 2009 the highest average temperature in June was at 28.79°C, whereas the highest humidity in October was 77.00%. In 2010, the temperature level, relative humidity and raining were higher than in 2009 season every month (except raining in October 2009). The temperature levels were recorded between 28.40 and 29.40°C and the humidity was obtained between 77 and 80% (Table 4).

Discussion

In view of data for insect pests on okra under naturally experimental plot, it was found that none accessions of okra were able to resist insects 100%, impairment of all types of insects. However, the number of *A. gossypii*, *T. palmi*, *A. biguttula*, *B. tabaci* and *X. transversa* had increased in the same direction in both 2009 and 2010. Lucky file 473 had the lowest level of *A. gossypii* at 6.15±1.08 and 6.18±0.77 insects/plant in 2009 and 2010, respectively. KN – OYV – 14 had been lowest infested by *T. palmi* at 43.85±4.98 and 45.99±3.78 insects/plant in 2009 and 2010, respectively. The accessions being lowest infested by *A. biguttula*, *B.tabaci* and *X. transversa* were PC 52S5, KN – OYV – 03 and KN – OYV – 25 at 21.25±3.75, 6.43±1.57 and 0.35±0.06 insects/plant in 2009 and to be infested 23.26±2.75, 9.44±1.23 and 0.66±0.26 insects/plant in 2010, respectively. The results in this studies were less than those reported by Gandhi et al. (2006) and Leite et al. (2007) which an insect controlled experiment was conducted with various methods. Okra from the experiment one might be thickly trichome density, so the impairments of insects were less or those insect pests might be not like these accessions (Costa et al., 1991; Benchasri and Bairaman, 2010).

Development times of insects are influenced by temperature, relative humidity (RH), and diet (Subramanyam and Hagstrum, 1993). Temperature and relative humidity had an effect on the quantity of all kinds of insects. As the temperature and humidity in 2010 were higher than 2009 season in every month, it had caused quick and big expansions of insects (Sedaratian et al., 2010). However, the distribution of many insect species is limited by temperature (Alexander et al., 2004; Khan et al., 2008). Insects cannot develop below a threshold of temperature and they need to accumulate enough day degrees to complete their life cycle (Lamb, 1992; Gilbert and Raworth, 1996; Addo-Bediako et al., 2000; Danks, 2000; Stacey and Fellowes, 2002). Besides, Athar et al. (2011) had additionally reported that the nutrient level on okra was one of the factors affecting on the quantity of insects increasing. Okra with high level of N was likely to be easier infested by insects than those with low level of N. These results could be supported by the findings of Jauset et al. (1998) who reported that aphids

Table 4
Temperate and relative humidity between June and October in 2009 and 2010

Months (2009)	Temperature/Month (°C)			Relative Humidity (RH)/Month (%)			Rain, mm
	Maximum	Minimum	Averages	Maximum	Minimum	Averages	/Month
June	29.78	26.86	28.79	85.00	71.00	75.00	31.60
July	29.92	26.91	28.05	89.00	69.00	76.00	80.50
August	29.36	26.51	28.30	86.00	67.00	75.00	70.00
September	29.49	26.66	28.05	84.00	70.00	76.00	45.40
October	30.20	25.05	27.58	97.00	65.00	77.00	732.40
Months (2010)	Temperature/Month (°C)			Relative Humidity (RH)/Month (%)			Rain, mm
	Maximum	Minimum	Averages	Maximum	Minimum	Averages	/Month
June	33.80	25.00	29.40	93.00	61.00	77.00	49.70
July	33.20	24.30	28.80	94.00	62.00	78.00	118.50
August	33.20	24.40	28.80	95.00	62.00	78.00	101.50
September	33.10	24.40	28.40	95.00	64.00	79.00	87.40
October	32.20	24.40	28.40	94.00	66.00	80.00	255.20

and whitefly females aggregated and laid more eggs on leaves/plants with the highest nitrogen and water content. Whereas, N and K levels and leaf chemical composition were not correlated with whitefly and *Aphis gossypii* population (Leite et al., 2005; Fasunwon and Banjo, 2010). However, quantitative analyses of environmental and nutrient effects on insects help researchers understanding, predicting or comparing population trends of insects living in the same or diverse habitats (Hagtrum and Throne, 1989).

Conclusion

The average of *A. gossypii* , *T. palmi*, *A. biguttula*, *B. tabaci* and *X. transversa* in 2009 and 2010 were found that the number of insects were entirely significantly different and none of the accessions were able to resist the insect pests 100% (not found insects). However, Lucky file 473, KN – OYV – 14, PC 52S5, KN – OYV – 03 and KN – OYV – 16 were extremely able accessions to resist *A. gossypii*, *T. palmi*, *A. biguttula*, *B.tabaci* and *X. transversa,* respectively, due to their being damaged by insects the least. Thus, an experiment should be conducted again to confirm by adding experimental period during raining, summer and winter seasons in order to search the clear results before extension to agriculturists.

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