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EFFECT OF CERTAIN AGRICULTURAL PRACTICES ON SOME PIERCING SUCKING PESTS ATTACKING COWPEA PLANTS

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ABSTRACT: *The present study aimed to reach suitable control program to control the important piercing sucking pests infesting cowpea plants (spider mites, whitefly and thrips). Studies focused on the rates of infestation by different pests of three cowpea varieties, the effect of sowing date and the different fertilizer treatments. Moreover, the phytochemical compounds of cowpea leaves infested by whitefly, Bemisia tabaci and a comparison of some anatomical studies of the three developmental stages i.e. seedling, vegetation and oldness were estimated hoping to find out the factors responsible for relative resistance of susceptibility.*

Data revealed that Dokki 331 recorded the highest infestation rate by the spider mites, Tetranychus urticae Koch, Tetranychus cucurbitacearum (Sayed) and Thrips tabaci Lindquist while, Kafr El-Sheikh was the least infested variety by the three pests. Statistical analysis of data show insignificant differences between the mean of infestation by different piercing sucking pests infested different varieties. Delaying the planting date of cowpea plants to April, 30th enhanced higher T. urticae infestation while B. tabaci (Gennadieu) and Th. tabaci L. contributed the lowest infestation. For Yield, sowing date of the cowpea in the earliest date, April, 1st led to have the highest dry pods' yield.

Key words: *Aphid, cowpea, infestation levels, piercing sap sucking pests, spider mite, Thrips sp., Tetranychus. urticae , T. cucurbitacearum varieties, whitefly.*

INTRODUCTION

Vegetable crops shelter several pest species, some of which are phytophagous causing qualitative and quantitative reduction in the yield (Abdel-Salam *et al.,* 1980). Cowpea, *Vigna unguiculata* (L) considered one of the most important leguminous vegetable crops in Egypt. Their grains provide high carbohydrate together with moderate protein (25%), low fat and several vitamins and minerals. The plant tolerates drought, performs well in a wide variety of soils, and being a legume replenishes low fertility soils when the roots are left to decay.

Piercing sucking pests e.g. spider mites, whiteflies and thrips are widely spread attacking a wide variety of agricultural crops and causing considerable damage.

The two spotted spider mite, *Tetranychus urticae* Koch is considered one of the important pests during summer plantation causing various degrees of damage. The mites feed on the epidermis and puncture parenchyma cells, leaving light-colored stipples on the leaf surface and interfering with photosynthesis (Tomczyk *et al.* 1985). *T. urticae* often occurs simultaneously in the field with *B. tabaci* on bean, eggplant, tomato, cowpea and cucumber.

Nymphs and adult of *Thrips tabaci* are not less in their seriousness than spider mite; also *Bemisia tabaci* is highly polyphagous pest, infesting more than 600 plant species including a many varieties of vegetable and ornamental plants (Secker *et al.* 1998); its damage is caused directly by feeding on phloem or deposition of honeydew, or indirectly by physiological disorders and transmission of more than 150 plant viruses (Oliveira *et al.* 2001).

Therefore future research is needed to reveal the factors affecting fertilizer treatments. Macro-nutrients are the main

nutrients plants needed and are usually included in all fertilizers. These nutrients, which include nitrogen, phosphorus, potassium, calcium, magnesium and sulfur, are necessary to help plants develop new growth as well as fortifying the structure and defenses of the existing plant cells.

The present study was carried out as a trial to highlight the sensitivity of three cowpea varieties, the effect of the planting dates and the effect of different levels of fertilizers on the infestation of cowpea plants by some piercing sucking pests and on the resultant yield. Moreover, the anatomical* characters of cowpea leaves of the three cultivars at different stages of plant growth

MATERIAL AND METHODS

This experiment was conducted in the experimental farm of the Faculty of Agriculture, Moshtohor, Qualubia Governorate in summer plantations to evaluate some agricultural practices. Moreover, the obtained dry pods' yield of cowpea from different treatments was transferred to that produced per feddan.

A – Field studies

Three field experiments were carried out through summer plantations.

The first experiment is to evaluate the sensitivity of three local varieties of Cowpea, *Vigna unguiculata* L. (Balady, Kafr El-Sheikh and Dokki 331) to the infestation of four sap sucking pests, *Tetranychus urticae* Koch, *T. cucurbitacearum,* (Sayed), *Bemisia tabaci* (Genn.) and *Thrips tabaci* (Lind.).

An area of about 0.011 feddan (46.2 m^2) was cultivated with the three cowpea varieties. The area was divided into nine equal plots; each of about 4.2 m^2 was planted in rows of 3.5 long and 60 cm apart. All plots distributed randomized. Seeds of each variety were sown at end of April during 2008 season of three replicates each. The dry pods of each cowpea variety were collected and weighted to estimate the final yield.

The second experiment, the cowpea variety, "Dokki 331" was sown at three different planting dates, April 1st, 15th and 30th to evaluate the effect of sowing date on the infestation by the previously mentioned pests.

The experiment area (46.2 m^2) was divided into nine plots, each of 4.2 m^2. Plots were distributed in a randomized complete block design with three replicates for each date. At the end of the season, the dry pods of each planting date were picked and weighted to estimate the final yield.

The third experiment is to recognize the effect of different rates of nitrogen, phosphorus and potassium fertilizers on the level of infestation by the 4 previously mentioned piercing sucking pests to the Dokki 331 cowpea variety and on the yield. Seeds of Dokki 331 variety were sown on April 15th, the experimental area was about 0.015 feddan (63 m^2) divided into 15 plots of 4.2 m^2 each for the 4 different fertilizers and the control (3 replicates for each treatment). Plots were distributed in randomized complete design. When the dry pods of cowpea reached the time of harvest, these pods were picked up and weighted.

All plots received the normally recommended agricultural practices & kept free from any pesticides. The tested fertilizer used as follow:

1- Ammonium nitrate, 33.5% N_2 used by the rate of 100 kg/feddan.
2- Calcium super phosphate, 15% P_2O_5 used by the rate of 200 kg/feddan.
3- Potassium sulfate, 48% K_2O used by the rate of 100 kg/feddan.
4- A mixture of the 3 previous fertilizers N, P & K at the rate of 100, 200 and 100 kg/feddan respectively.
5- The control plots (without any treatments).

Sprays were applied two times, the first after complete germination and the second spray on leaves at the time of flowering. The control plots were treated with water in the same days of spraying fertilizers.

Laboratory studies

a- Estimation of cowpea leaves components:

The phytochemical components of leaves for cowpea Dokki 331 varieties were

estimated to determine the relation between the plant components and the population density of white fly *B.tabaci* in three planting dates under field condition in 2008 season.

Leaves of each sample were cleaned and washed with distilled water, then quickly dried by placing them gently between filter papers to remove the excess of water. The fresh weight of leaves was recorded. The leaves were placed in dry oven at 60°C for one day. The dry powder of leaves was stored in glass bottle to determine carbohydrates, total protein, the percentages of reduced total sugars and non reduced total sugars according to Association of Official Analytical Chemists, A.O.A.C. (1995).

b- Anatomical characters of cowpea leaves

Anatomical characters of leaves of the three tested cowpea varieties in three different developmental stages (seedling, vegetative and oldness) were carried out. In the laboratory, samples were cleaned with tap water, cut into suitable parts, fixed in formalin, acetic acid, alcohol (F.A.A) solution for at least 36 hours, dehydrated with n-butyl alcohol, infiltrated and embedded in pure paraffin wax (M.P. 56-58°C) (Johansen, 1940). Sectioning at thickness of 14 micron was performed by using a rotary microtome. Paraffin ribbons were mounted on glass slides for examination and stained with safranin and light green (Corgan and Widmoyer, 1971). Sections were mounted in Canada balsam then examined microscopically. The epidermal cell thickness was measured by planimeter (Saeed, 1992).

Sampling technique

Sampling started 24 days after sowing of cowpea seeds and continued weekly for 10weeks until harvest in the three experiments.

Samples of 10 leaflets from each replicate were randomly picked from three levels of plant, then kept in tightly closed paper bags and transferred to the laboratory where the observed pests were counted by the aid of stereomicroscope. The total individuals of *T. urticae, T. cucurbitacearum* (moving stages), *B. tabaci* (nymph and pupal stages) and *T. tabaci* (nymphs and adults) were estimated by counting the total numbers on the upper and lower surfaces of the leaflet.

Statistical analysis

The analysis of variance was adopted for each experiment and the L.S.D values were used to determine the significance between means, Snedecor and Cochran 1981).

RESULTS AND DISCUSSION

Data in (Table 1) showed that Dokki 331 was the most susceptible variety to infestation by *T. urticae* and *T. cucurbitacearum* which had the highest infestations of mean number 0.9 & 0.2 individuals/ leaflet, respectively. Baladi variety found out its susceptibility to infestation by *B. tabaci*, which revealed the highest infestation (0.6 individual / leaflet); while K.El-Sheikh variety got out the lowest infestation by *Thrips tabaci*, recorded 0.04 individual /leaflet.

Statistical analysis of data show insignificant differences between varieties

Dokki 331 variety gave the lowest dry pods' yield (Table1) with average 0.81 tons/fed. On the other hand, Baladi variety gave the heaviest dry pods of yield with average 1.95 tons/fed with significant differences between mean counts of the three varieties. It means high pest infestation correlated with low dry pods' yield.

In (Table 2), it could be noticed that the pests *Tetranychus urticae* and *T. cucurbitacearum* showed the lowest infestation in the second planting date April, 15^{th,} (0.3 & 0.04 individuals / leaflet, respectively), while the pests *Bemisia tabaci* and *Thrips tabaci* recorded the highest infestation in the same date (0.5 & 0.04 individuals / leaflet, respective). By delaying the planting date of cowpea plants (April, 30th) the numbers of movable stages of *T. urticae* were increased (1.3 individuals / leaflet) while *Bemisia tabaci* and *Thrips tabaci* contributed the lowest infestation 0.3 & 0.02 individuals / leaflet, respectively; with no significant differences between means of planting dates.

Table (1): The sensitivity of three Cowpea varieties to some piercing sucking pests and their effect on the resultant yield

Varieties	Mean number of pest / leaflet				Yield Tons /fed.
	Tetranychus urticae	*Tetranychus cucurbitacearum*	*Bemisia tabaci*	*Thrips tabaci*	
Balady	0.4	0.1	0.6	0.05	1.95
K. El-Sheikh	0.3	0.1	0.5	0.04	1.07
Dokki 331	0.9	0.2	0.5	0.09	0.81
LSD at 5%	0.7	0.1	0.2	0.13	0.57

Table (2): The effect of the planting date on the infestation of cowpea plants by some piercing sucking pests and on the resultant yield

Planting dates	Mean number of pest / leaflet				Yield Tons /fed.
	Tetranychus urticae	*Tetranychus cucurbitacearum*	*Bemisia tabaci*	*Thrips tabaci*	
1st April	0.4	0.06	0.4	0.03	1.02
15-April	0.3	0.04	0.5	0.04	0.68
30-April	1.3	0.06	0.3	0.02	0.54
LSD at 5%	1.5	0.1	0.2	0.05	0.42

The earliest planting date harbored intermediate infestation for the pests *T. urticae* , *Bemisia tabaci* and *Thrips tabaci* 0.4, 0.4, &0.03 individuals / leaflet, respectively.

Data revealed that the mean number of *T. urticae* were increased by delaying the planting date of cowpea plants, this data go in line with the finding of Wahba (2000) who studied the effect of three planting dates on pest infestation to cowpea plants (Cream7 variety) and he recorded the highest infestation rate by T. *urticae* and the lowest by *Thrips tabaci* in the late planting date April 30th.

The yield of dry pods of the three planting dates related with decrease by delaying the planting date. Plants cultivated in the earliest date (April, 1st) connected with the largest dry pods' yield with mean 1.02 tons/fed, followed with the second date (April, 15th) which gave 0.68 tons/fed.; while, the latest date (April, 30th) gave the lowest dry pods' yield with average 0.54 tons/fed., with significant differences between means of the first and third date of planting. These results agreed with Wahba (2000), who proved that the highest yield was associated with the sowing in the first planting date (285.75 kg. / Feddan) comparing to the late planting date (256.96 kg. / Feddan).

Also, Bationo *et al.* (2001) recorded that the management practice which combined early planting and close spacing was the most effective in reducing all pest infestations followed by sole foliar sprays

The effect of different levels of fertilizers on the infestation of cowpea plants by some piercing sucking pests and on the resultant yield

The ammonium nitrate treatment in (Table 3) showed the lowest infestation by all the mentioned pests with insignificant differences between the untreated treatments and the other treatments for the infestation by the two spider mites and *Thrips tabaci*; while Potassium sulfate

treatment revealed the highest infestation to pests except of *B. tabaci* which recorded the highest infestation in the trial of Calcium super phosphate treatment with significant differences between means.

Treatment with the mixture of (NPK) gave the highest dry pods' yield in the fertilizer treatments which revealed 1.92 tons / fed. On the other direction, Potassium sulfate treatment gave the lowest dry pods' yield with mean 0.37 tons/fed. While plants which kept free from any fertilizer (control) and those of ammonium nitrate and Calcium super phosphate treatment demonstrated the intermediate rate of dry pods' yield with averages 0.65, 0.63 and 0.56 tons / fed., respectively.

Our results clearly show that population build-up of the different insect pests depended on management practice. However, a treatment with a mixture of NPK were the best treatment, stress the pest populations and increases the productions

The phytochemical components of cowpea leaves, Dokki 331 variety at high infestation with *B. tabaci* in three planting dates

Data in Table (4) indicated that the percentages of total protein contents in cowpea plant leaves were approximately fair in the leaves of first, second and third planting dates (29.46, 29.46 and 29.17%, respectively) with insignificant differences between them.

First and second planting dates showed lower total carbohydrate contents than the third date (5.24 and 6.72%, respectively) being insignificant differences between them and significantly lower than the third date (32.61%).

Table (3): The effect of different levels of fertilizers on the infestation of cowpea plants by some piercing sucking pests and on the resultant yield

Fertilizer treatments	Mean number of pest / 30 leaflets				Yield Tons /fed.
	Tetranychus urticae	*Tetranychus cucurbitacearum*	*Bemisia tabaci*	*Thrips tabaci*	
N (100kg/fed)	0.3	0.03	0.3	0.04	0.63
P (200kg/fed)	0.7	0.05	1.7	0.07	0.56
K (100kg/fed)	0.9	0.07	0.5	0.09	0.37
NPK (1:1:1)	0.4	0.04	0.6	0.05	1.92
Control	0.1	0.01	0.5	0.04	0.65
LSD at 5%	0.8	0.08	0.9	0.2	0.46

Table (4): Determination of the percentage of protein, carbohydrate and sugar in cowpea plant during 2008 season

Planting dates	Sample weight	Protein %	Sample weight	carbohydrate %	Sample weight	Sugar %	Reduction Sugar %
1st April	0.1	29.46	0.1	5.24 c	1.5	0.28	4.93 c
15-April	0.1	29.46	0.1	6.72 b	1.5	0.31	6.4 b
30-April	0.1	29.17	0.1	32.61a	1.5	0.31	32.47 a
LSD at 5%	3.57		1.4			0.12	1.38

The percentage of total sugar content in cowpea plant leaves of first planting date was lower (0.28%) than the two other dates (0.31) showing insignificant differences between them. The total reduced sugar contents were higher in the third planting date (32.47%) being significantly higher than the two other dates. Meanwhile, the first planting date showed the lowest total reduced sugar contents in their leaves (4.93%) being insignificantly with the second date and significantly lower with the last date.

Population abundance of *B. tabaci*, adults on cowpea plants during high infestation showed insignificantly relation with total protein and total sugar. While, negative correlation value was calculated in cases of carbohydrate and reduced sugar.

Anatomical* characters of cowpea leaves of three cultivars at different stages of plant growth:

The leaf anatomy* of three cowpea cultivars, Baladi, Kafr El-Sheikh and Dokki 331 in three different developmental stages, seedling, vegetative and oldness was experimented. The obtained results (Table 5) cleared the histological changes of the three cowpea cultivars. By comparing the anatomical characters of their leaves, we can conclude that the vegetative stage is the most important stage which has the production of the fruits. Considering the Baladi cultivar had the highest production, so its morphological characters must be compared to those of the other cultivars.

Firstly, the thickness of the cuticle which is a layer protect the epidermis cells recorded 11.25 & 9 µ for upper and lower layers, respectively, more than those recorded for K. El-sheikh and Dokki331 (9, 9.45 and 5.4, 8.1 µ) for upper and lower layers, respectively.

The epidermal layers differ in their thickness in the different developmental stages and in turn in different cultivars whereas the increased thickness was higher in upper epidermis than in lower one in the three stages; the Baladi cultivars recorded the lowest thickness comparing to the other cultivars.

Table (5): The leaf anatomy of three cowpea cultivars in three different developmental stages

Thickness of histological characters (micron)	Seedling			Vegetative			Oldness		
	Baladi	K-El-Sheikh	Dokki331	Baladi	K-El-Sheikh	Dokki331	Baladi	K-El-Sheikh	Dokki331
Cuticle									
a- Upper layer	9.00	11.70	9.90	11.25	9.00	9.45	11.70	11.70	13.50
b- Lower layer	7.20	9.00	8.10	9.00	5.40	8.10	9.00	9.00	9.00
Epidermis									
i- Upper epider.	34.20	44.10	40.95	31.15	36.00	32.85	41.4	35.1	53.10
ii- Lower epider.	24.30	20.70	23.40	20.25	22.50	27.90	21.60	27.00	31.50
Mesophyll									
-i- Palissade layer	3	2	2	3	2	2	2	2	2
ii- Spongy tissue	155.70	157.5	189.00	205.20	201.60	169.20	234.00	216.00	286.20
Vas. bund. length	351.9	334	333.9	157.5	319.9	256.5	361.8	275.4	324
i- Xyllem	254.70	232.00	263.70	113.40	237.60	180.00	280.80	187.20	247.50
ii- Phloem	97.20	102.00	70.20	44.10	82.35	76.50	81.00	88.20	76.50
Midrib	720.00	527.00	770.40	630.0	108.00	571.50	922.50	848.70	1215.00
Blade	429.30	351.00	400.05	410.85	385.20	426.60	484.20	449.10	588.5

Vas. bund.: vascular bundle

* *Leaves and Leaf Anatomy http://www.enchantedlearning.com/subjects/plants/leaf/

With regard to cuticle layer thickness Antonio *et al.* (2005) reported that most epidermis cells of the aerial parts of higher plants (such as leaves, fruits and non woody stems) as well as some bryophytes are covered by a continuous extra cellular membrane of soluble and polymerized lipids called the cuticle or cuticular membrane CM. The structure and composition of the cuticular membrane varies among plants, organs and growth stages. On dry land, the main function of the CM is to minimize water loss. However from a general point of view, this role in the regulation of plant water loss is accompanied by other important functions. The CM limits the loss of substances from plant internal tissues, protected the plant against physical, chemical and biological attacks and protects the plant against the external environment stress. The cuticular membrane in association with the epidermis is the morphological structure that confers the main mechanical strength to plant organs.

The mesophyll consisted of two layers, the first layer is the palisade mesophyll, which is a layer of elongated cells located under the upper epidermis contain most of the leaf's chlorophyll, converting sunlight into usable chemical energy for the plant. In the experimented cultivars, the baladi variety recorded three rows of palisade mesophyll where gas exchange occurs in the air spaces between the cells while the two other cultivars recorded only two rows. The second layer is the spongy tissue which is below the palisade mesophyll layer; it has many air spaces between the cells which contain some chlorophyll; the spongy tissue of Baladi cultivar more thickened than those of the two other cultivars where they recorded 205.2, 201.6 and 169.2 µ for Baladi, Kafr El-Sheikh and Dokki 331, respectively.

The vascular bundle or vein, provide support for the leaf and transport both water and minerals via xylem and food energy or sugar via phloem through the leaf and on to the rest of the plant or on to fruits; both of these structures recorded the least values in Baladi cultivar followed by Dokki 331 cultivar then Kafr El-Sheikh cultivar (157.2, 256.5 and 319.9 µ , respectively.

The highest thickness of midrib (the central part of a leaf which transports food, water, and minerals to the plant and it is usually continuous with the petiole) was occurred in Baladi cultivar 630 µ followed by Kafr El-Sheikh 571.5 µ then Dokki 108 µ, respectively.

The blade leaf of Baladi cultivar recoded intermediate thickness between the two other cultivars (385.2, 410.85 and 426.6 µ for Kafr El-Sheikh, Baladi and Dokki 331, respectively. It's functioning as a principal organ of photosynthesis and transpiration in most plants.

In general, these positive alterations in leaf anatomy of Baladi cultivar were completely reversed upon vegetative and led to vigorous growth and enhancement of flowering and high increases in the final fruit yield (pods). Also, these positive responses of different anatomical aspects and the histological features of leaves studied by Wanas (2007) to improve growth and productivity of tomato plants.

However, in Oldness stage, an obvious increase was observed in the thickness of all the anatomical structure in the three cultivars due to their development and to the heavy infestation which occurred at the end of the season. The blade of leaf increased in different stages to reach its maximum values (588.5µ) in Dokki 331, while Baladi and Kafr El-Sheikh recorded 484.2 µ and 44.9 µ, respectively. These results agree with El – Zoghby *et al.* (2009) who proved that plants infested with mites showed an increase in the thickness of upper and lower epidermis of the leaf lamina compared to control.

Thereby, improvement the histological features of leaves could be considered as a direct reason for increment the final fruit yield.

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تأثير بعض العمليات الزراعية على الآفات الثاقبة الماصة التي تصيب نباتات اللوبيا في مصر

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تعتبر اللوبيا من أهم المحاصيل البقولية المزروعة في مصر بالحقل المفتوح وتحت الصوب. ازدادت المساحة المنزرعة بها خلال السنتين الأخيرة خاصة فى أراضي الاستصلاح الجديدة للاستهلاك المحلي والتصدير للأسواق الدولية.

أجريت هذه الدراسة خلال موسم 2008 في مزرعة كلية الزراعة التجريبية بمشتهر لمعرفة تأثير ثلاثة أصناف من اللوبيا – الدقي ، وبلدي، وكفر الشيخ – على الكثافة العددية للأكاروس العنكبوتي بنوعيه الأحمروالأخضر *Tetranychus urticae, T. cucurbitacearum* (الأطوار المتحركة) والذبابة البيضاء *Bemisia tabaci* (الحوريات و العذراى) ، و التربس *Thrips tabaci* (حوريات وحشرات كاملة)، وكذلك دراسة تأثير ميعاد الزراعة وأنواع التسميد المختلفة على معدل الإصابة بهذه الآفات وأيضاً على المحصول الناتج وكان ملخص النتائج كالتالي:

1–الأصناف

الصنف "دقي 331" أعطي أقل محصول قرون جافة بمتوسط 0.81 طن/ فدان . من ناحية أخري الصنف "بلدي" أعطي أعلى نسبة إنتاج من القرون الجافة بمتوسط 1.95 طن/ فدان بينما كفر الشيخ أعطي معدل متوسط من المحصول بمتوسط 1.07 طن/ فدان.

2– ميعاد الزراعة

أرتبط محصول القرون الجافة لمواعيد الزراعة الثلاثة بالإنخفاض مع تأخير ميعاد الزراعة.

النباتات المزروعة في الميعاد المبكر (1 أبريل) أعطى أكبر محصول من القرون الجافة بمتوسط 1.02 طن/فدان يتبعه ميعاد الزراعة المتوسط (15إبريل) الذي أعطي 0.68 طن/فدان بينما ميعاد الزراعة الأخيرة (30 إبريل) أعطي أقل محصول قرون جافة بمتوسط 0.54 طن/ فدان.

3– معاملات التسميد

أعطت معاملة الخلط (NPK) أكبر محصول من القرون الجافة التي أظهرت بمتوسط 1.92 طن/فدان في الاتجاه الآخر أعطت معاملة سلفات البوتاسيوم أقل محصول من القرون الجافة بمتوسط0.37 طن / فدان بينما أظهرت كل من النباتات التي حفظت بدون تسميد (كنترول) وهؤلاء من التسميد النيتروجيني والفوسفوري معدل متوسط من محصول القرون الجافة بمتوسط 0.65 ، 0.63 ، 0.56 طن/ فدان تقريباً على التوالي.