Effect of some insecticides in reducing the population of two aphid species, *Rhopalosiphum maidis* and *Schizaphis graminum* on sorghum varieties, Horus and Dorado.

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ABSTRACT

Toxicity of spinosad, two nicotinoids, acetamiprid and imidacloprid, and two conventional insecticides, chlorpyrifos and cypermethrin were tested in the field against two aphid species, *Rhopalosiphum maidis* (Fich) and *Schizaphis graminum* (Rondani) infesting two sorghum varieties, Horus and Dorado. *R. maidis* started to infest the two sorghum varieties by the last week of June and continue till the first half of August. While, *S. graminum* started to infest both sorghum varieties by the first week of August and continue till the third week of September. Two spray treatments were conducted by Knapsack sprayer the first one was in June 30th and the 2th second was in August 7th. Reduction percent in the number of aphid eggs and nymph due to the insecticide treatments was calculated 3, 17, and 37 days after treatment. Eggs and nymphs of population *R. maidis* and *S. graminum* were strongly decreased in all treated Horus and Dorado varieties after 3 days from insecticides application as compared with control. Spinosad and nicotinoid compounds were more effective than the two conventional insecticides, chlorpyrofos and cypermethrin in controlling both species of aphid, on the two sorghum varieties. The descending order of the insecticides activity was imidacloprid, acetamiprid, spinosad, chlorpyrifos and cypermethrin in all experiments of this study.

INTRODUCTION

Sorghum (*Sorghum vulgare* L.) is considered the most important cereal crop grown principaly during summer in upper Egypt. Sorghum was cultivated for a long time ago for breed making, and recently for many other purposes such as

green foliage, grains for feeding animals, and as row material for industries. It is cultivated in about half million feddans in upper Egypt **(Anonymous, 2001).** Sorghum plants are attacked with the corn leaf aphid, *Rhopalosiphum maidis*.(Fam.Aphididae) and *Schizaphis graminum* (Fam: Aphididae).Aphids are first noticeable in the whorl and upper leaves, but when the tassel appears they breed abundantly on it. Severe feeding may cause death of parts of leaves or even the plant. Less severe and more common infestations result in a reduction or even prevention of pollen shedding on a part or all of the tassel. In this manner, if aphid population are common enough, grain production is reduced through partial prevention of pollination,(**El-Heneidy et al., (2004); Slman et al., (2006) and Michels and Matis (2008)).**

Recommendations for the integrated management of insect pests in sorghum involve cultural practices, natural enemies, insecticides and host plant resistance (HPR). In rainfed agriculture, the sowing date cannot be manipulated to avoid pest damage. Insecticides are expensive, uneconomical and beyond the reach of resource–poor farmers in the semi-arid tropics. HPR is the most important component of integrated pest management in sorghum; it does not involve any extra cost or require application skills in pest control techniques, and is compatible with other methods of pest control. The negative effect of resistant genotypes on insect populations is continuous and cummlative over time. Reduction in pest populations through HPR can also enhance the effectiveness of natural enemies and reduce the need to use pesticides **(Sharma, 1993). Margery (2003)** reported that due to a different mode of action, neonicotinoids control many important pests that have evolved strains resistant to most other insecticides. Acetamiprid, a member of the neonicotinoid insecticide family, is a fairly new insecticide that has recently entered the market place. Its unique mode of action offers control against many important pests that had previously evolved resistant strains to most insecticides. Acetamiprid is very selective and provides outstanding control of sucking pests such as aphids and whiteflies without having detrimental effects on non-targets.

3. MATERIALS AND METHODS

The insecticides which used in this experimental are get up from center laboratory of pesticides, Doki, Egypt.

3.1. Chemical structure of the tested insecticides:-

3.1.1. Biocide

1. spinosad

Formula: $C_{41}H_{65}NO_{10}$ (spinosyn A) ± $C_{42}H_{67}NO_{10}$ (spinosyn D)

Formulations : 48% EC

Common name: spinosad

Trade name : Tracer

3.1.2. Nicotinoid insecticide
A. Neonicotinoid insecticide

1. acetamiprid

Formula:$C_{10}H_{11}ClN_4$

Formulations : 20%SP, 20%SL,70%WP, 70%SP

Common name : **acetamiprid**

Trade name: Assail

B. Chloronicotinoid insecticide
1. imidacloprid
Formula: $C_9H_{10}ClN_5O_2$
Formulations : Water-soluble packet

Common name : **imidacloprid**

Trade name: Gaucho,

3.1.3. Organophosphorus group:
Chlorpyriphos

Formula : C9H11Cl3NO3PS

Common name: chlorpyriphos

Trade name : Dursban

Formulations: 48% EC

3.1.4-pyrethroid group:
Cypermethrin

Formula : C22H19Cl2NO3

Trade name : Ripcord

Formulations : 20% EC

3.2.Crops

1-The sorghum **Dorado** (hybrid variety and short variety with wide-leaves**)**

2- The sorghum **Horus** (hybrid and long variety)

3.3. Insect tests.

1-Corn leaf aphid *Rhopalosiphum maidis*

2-Greenbug aphid *Schizaphis graminum*

3.3. Field studies

3.3.1. Sampling technique

Field experiments were carried out in the experimental farm of Faculty of Agriculture, AL-Azhar University, Assiut governorate. The experimental area was divided into smal1 plots (1/100 fed), Plots were separated from each other by 1 meter of bare ground. Randomized compete block design was followed in the whole experimentation area, and each treatment was replicated five times. The experimental unit was10.5 square meters held five rows 3.5m length and 60 cm inter rows. Plantation was carried out on 25cm distance for long varieties, and 20 cm for short varieties. Usual agriculture practices were done according to Ministry of Agriculture recommendation.

Samples of 10 plants were investigated weekly from each replicate. Ten leaves were randomly selected to count aphids nymphs. Trapped insects were immediately collected in ordinary cyanid jar, and then transported to the laboratory in polyethylene bags where they were spread on white paper sheet for enumerating, identification, counting and recording. Abundance, population density, occurring time, stage and status of the insects existing in intercropped and monoculture systems were recorded and tabulated.

In all cases, field collected insects from different treatments which transported to the laboratory were enumerated, identified and counted made by specialist persons in departments of aphidology and Insect Collections & Identification, Plant Protection Institute

3.3.2. Method of insect survey in field

The following methods were used to determine the effect of tested compounds and agriculture practices on the populations of pests and beneficial arthropods in sorghum ecosystem.

Sampling start as soon as plants appeared above ground. Number of different life stages of pests and natural enemies were recorded weekly with 5 methods as follows:-

1- **Direct counts** of different stages of different pests and predators on10 plants/plot

2- Sweep net catch:

A sweep net (37 cm diameter) was used to collect arthropod predators in sorghum fields (4 double sweep / plot to one replicate in all treatments intervals were carried out. Samples were taken weekly and inspected using a binocular microscope for later identification and the fauna was sorted. Counts were calculated and expressed as total of insects from the two methods / plot.

These studies focused on two major aphid pests named the corn leaf aphid, *R. maidis* and the Greenbug aphid *S. graminum*(Rondani).

3.4. Insecticide treatment in the field:-

3.4. 1.Spraying technique

The amount of water required to provide sufficient spray liquid was 200 liters/fed. Imidacloprid , acetamiprid, spinosad, chlorpyrifos and cypermethrin were sprayed with knapsack sprayer. When the infestation percent started to be economic, two sprays were applied 1st spray was in June 30th , and the 2nd spray was in August. 7th (in 2009 season)

3.4.2. Determination of percentage reduction in the population after treatment with insecticides in sorghum fields.

Samples of 10 plants were investigated randomly from both diagonals of each plot to asses the sorghum plant infestation and the number of aphids *R. maidis* and *S. graminum*. A total of 30 plant / treatment were externally and internally

examined. The sampling procedure was conducted on the pre treatment and 3, 17 and 37 days after application in the two treatments.

Percentage of reduction in infestation was made according to **Henderson and Telton formula (1955),** as follows:

$$\% \text{ Reduction} = 1 - \frac{Ta \times Cb}{Tb \times Ca} \times 100$$ where:-

Cb = Aveg. % of infestation in check plots before spray.

Ta = Aveg. % of infestation in treatment plots after spray.

Tb = Aveg. % of infestation in treatment plots before spray.

Ca = Aveg. % of infestation in check plots after spray.

4. RESULTS AND DISCUSSION

The relative toxicity of acetamiprid, imidacloprid, spinosad, chlorpyrifos and cypermethrin were tested against the aphid population on sorghum at Faculty of Agriculture, AL-Azahar University, Assiut during 2009 season. Aphids were counted before and after insecticide application. Insecticides were applied after the appearance of eggs or nymphs in the field during 2009season.

1.1-Effect of the first spray with the tested insecticides on the population density of *R. maidis* on Horus plants in 2009 season:-

Population density of aphids was studied in the farm of Faculty of Agriculture, Al-Azhar University, Assiut. Data were recorded by counting aphids from upper, middle and lower leaves of three different plants of sorghum, selected randomly in each locality. Weekly data were recorded at each locality starting from June to September.Results in Table 1 and Fig. 1 revealed that population of eggs and nymphs of *R. maidis* on Horus plants was nearly the same in all the treated plants before application with insecticides in 2009.

The nymph population was strongly decreased in all treated plots after 3 day of application compared with control. Treatment with imidacloprid, acetamiprid and spinosad proved to be more effective against *R. maidis* (reduction was 94.62, 89.92 and 80.65 percent, respectively). Chlorpyrifos and cypermethrin were less effective representing only 75.27and 70.97%, reduction.

The percentages of reduction in aphid population after 17 days were 91.9, 85.12,71.4 , 66.18 and 57.65 for imidacloprid, acetamiprid, spinosad, chlorpyrifos and cypermethrin, respectively. The egg and nymph populations in all the plots, including control were reduced after 37 days from application representing percent reduction of 97.3, 94.8, 89.5, 85.2 and 55.5% for imidacloprid, acetamiprid, spinosad, chlorpyrifos and cypermethrin, respectively. These results are in agreement with the finding of **Elbert et al. (1998)**. They demonstrated that neonicotinoids were mainly acropetally transported in the xylem. This systemic property allows the chemical to become evenly distributed in the young, growing plant. **Kaniuczak and Matosz, (1998)** found that, the insecticide imidacloprid has considerable potential in faba bean IPM programs. Its use was still the subject of research but it is effective against aphids, wireworms, thrips and broad bean weevil *Bruchus rufimanus* Boh. **Bellettini et al. (1999)** found that acetamiprid gave greater than 91 percent control of *Aphis gossypii* on cotton for 2, 5, 7, 10 and 15 days after application. Cypermethrin and methamidophos gave 54.9 and 49.8 percent control, 2 days after application, and 0.5 and 13.4 percent control, respectively, 15 days after application. **Ahmed et al. (2001)** evaluated mixtures of imidacloprid and tebuconazole to determine their effects on plant stand, aphid's population and wheat grain yield. Plant stand increased and aphids' populations were effectively controlled for six to eight weeks after sowing. Substantial differences were observed among the treatments in the number of grains per ear and the 1000-grain weight. The differences reflected in 90-30% increase in the total grain yield.

Table (1).Effect of the first spray with the tested insecticides on the population density of *R. maidis* on Horus plants in 2009 season.

No.of aphid eggs and nymphs/leaf							
Month	Day	Control	Iimidacloprid	Acetamiprid	Spinosad	Chlorpyrifos	Cypermethrin
June	2	0	0	0	0	0	0
	9	0	0	0	0	0	0
	16	0	0	0	0	0	0
	23	0	0	0	0	0	0
	30	25	25	24	25	23	23
July	3	93	5	9	18	23	27
	10	343	21	43	92	95	119
	17	675	55	96	193	210	263
	24	520	38	43	186	120	193
	31	351	24	27	90	70	111
Aug.	7	220	6	11	23	30	90
	10	160	0	0	20	10	25
	17	0	0	0	0	0	0
	24	0	0	0	0	0	0
	31	0	0	0	0	0	0
Percent reduction	After 3 days	0	94.6	89.9	80.6	73.1	68.4
	After 17 days	0	91.9	85.2	71.4	66.2	57.6
	After 37 days	0	97.3	94.8	89.5	85.2	55.5

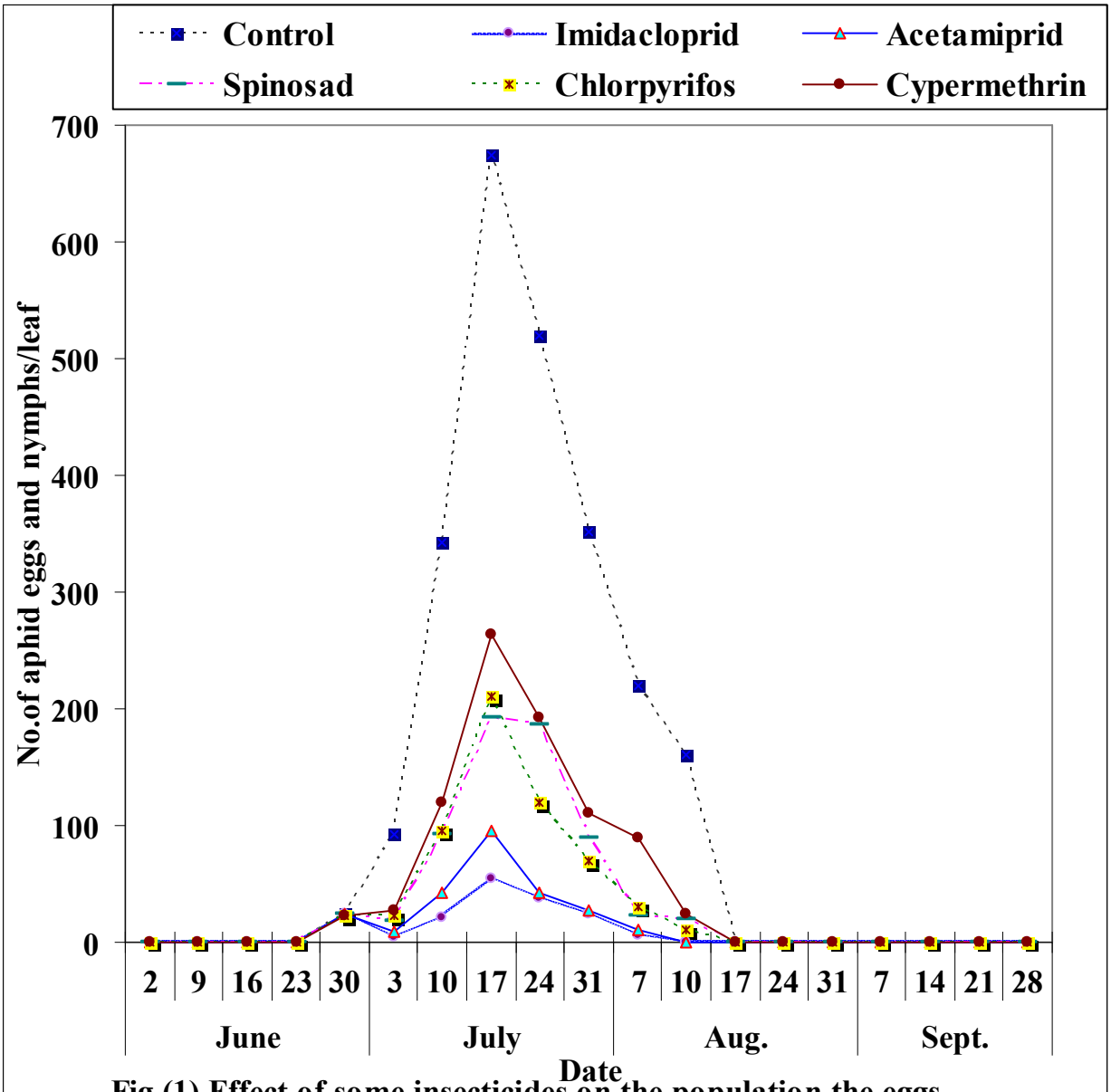


Fig.(1).Effect of some insecticides on the population the eggs and nymphs density of *R.maidis* on Horus plants in 2009 season.

1.2-Effect of the first spray with the tested insecticides on the population density of *R. maidis* on Dorado plants in 2009 season:-

Data presented in Table 2 and Fig. 2 Showed that egg and nymph populations of *R. maidis* on Dorado plants were nearly the same in all treatments before application with insecticides in 2009season.

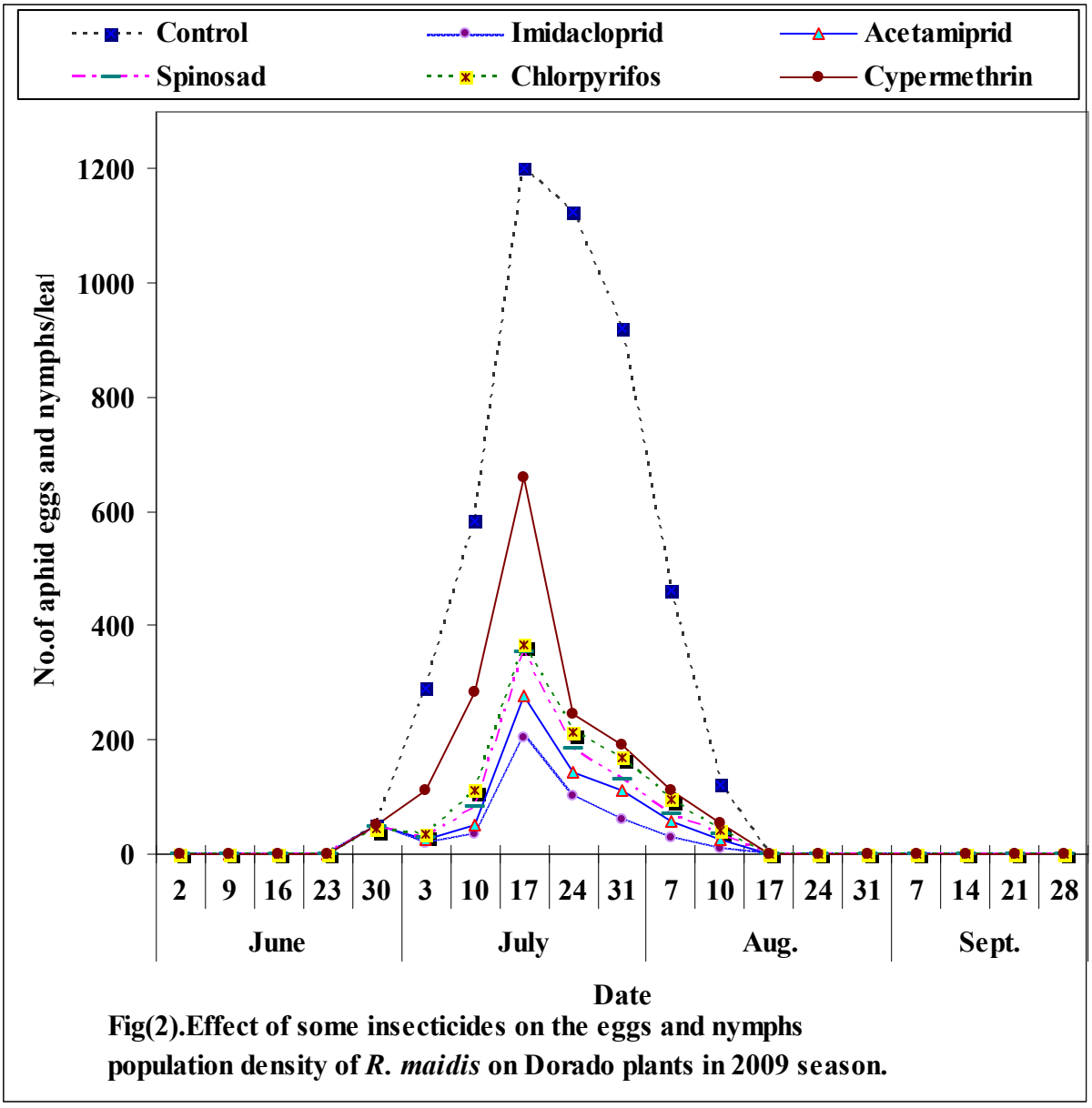
The egg and nymph populations were strongly decreased in all treated plots after 3 days of application with insecticides as compared with control. Treatment with imidacloprid, acetamiprid and spinosad were proved to be more effective against *R. maidis* as they caused 94.62, 91.7and 89.4% reduction, respectively. Chlorpyrifos and cypermethrin were less effective causing reduction percent 87 and 61.4%.

The reduction percent of all tested insecticides after 17 days of application were 83.6, 76.9, 68.6, 66.2 and 45.1%, for imidacloprid, acetamiprid, spinosad, chlorpyrifos and cypermethrin, respectively.

The egg and nymph populations in all the plots, were reduced after 37 days from application with the tested insecticides exhibiting 94.2, 87.5, 83.7, 77.2 and 75.8% percent reduction for imidacloprid, acetamiprid, spinosad, chlorpyrifos and cypermethrin, respectively. These results are in agreement with the results of **Mullins, (1993)** who stated that Imidacloprid has excellent root-systemic characteristics, and fair contact and stomach action. As a systemic treatment, imidacloprid is absorbed by the roots and transported mainly in the xylem where it is distributed evenly throughout young, growing plant tissues. **Yamamoto *et al.*(1995)** reported that, several analogs, including acetamiprid, thiamethoxam and thiacloprid, have since been discovered and have been shown to have the same mode of action as imidacloprid. This insecticide is neurotoxic, belongs to neonicotinoid group and has high systemic and translaminar action.

Table (2).Effect of the first spray with the tested insecticides on the population density of *R. maidis* on Dorado plants in 2009 season.

No.of aphid eggs and nymphs/leaf							
Month	Day	Control	Iimidacloprid	Acetamiprid	Spinosad	Chlorpyrifos	Cypermethrin
June	2	0	0	0	0	0	0
	9	0	0	0	0	0	0
	16	0	0	0	0	0	0
	23	0	0	0	0	0	0
	30	50	52	50	47	45	50
July	3	290	18	24	29	34	112
	10	583	34	51	84	112	283
	17	1201	205	277	354	365	659
	24	1124	103	142	186	212	246
	31	921	59	111	132	170	190
Aug.	7	463	28	58	71	95	112
	10	120	9	24	35	43	53
	17	0	0	0	0	0	0
	24	0	0	0	0	0	0
	31	0	0	0	0	0	0
Percent reduction	After 3 days	0	94	91.7	89.4	87	61.4
	After17 days	0	83.6	76.9	68.6	66.2	45.1
	After 37 days	0	94.2	87.5	83.7	77.2	75.8



Fig(2).Effect of some insecticides on the eggs and nymphs population density of *R. maidis* on Dorado plants in 2009 season.

3-Effect of the second spray with the tested insecticides on the population density of *S. graminum* on Horus plants in 2009 season.:-

Data in Table 3 and Fig. 3 show the effect of second spray using the tested insecticides to control *S. graminum* on sorghum plants. Results indicated that population of eggs and nymphs of *S. graminum* on Horus plants in all treatments before application with the tested insecticides were nearly the same in 2009 season.The nymph population was strongly decreased in all treated plots after 3 days of application compared with control. Activity of the tested pesticides were arranged in descending order as imidacloprid, acetamiprid, spinosad, chlorpyrifos

and cypermethrin, respectively, after 3 days from treatment. The reduction percent resulted from application with the previous insecticides were 90.51, 82.93, 78.63, 73.17 and 68.85 per cent, respectively. The corresponding reduction after 17 days were 76.23, 68.52, 57.15, 41.11 and 38.69 and after 37 days 80.6, 73.8, 61.7, 45.6 and 39.1. These results are in agreement with the finding of **Torres and Ruberson (2004)** they revealed that thiamethoxam and imidacloprid showed significant control of whitefly in comparison with untreated plants up to 40 days after treatment. **Orita and Kashio (2005)** found that neonicotinoid insecticides imidacloprid, nitenpyram, acetamiprid, and thiamethoxam showed high toxicity to adults of Aphidoletes aphidimyza (Diptera: Cecidomyiidae), and spinosad showed high toxicity. Some organophosphate and pyrethroid pesticides showed high toxicity to larvae.

Table (4).Effect of the second spray with the tested insecticides on the population density of *S. graminum* on Horus plants in 2009 season.

No.of aphid eggs and nymphs/leaf							
Month	Day	Control	Iimidacloprid	Acetamiprid	Spinosad	Chlorpyrifos	Cypermethrin
July	3	0	0	0	0	0	0
	10	0	0	0	0	0	0
	17	0	0	0	0	0	0
	24	0	0	0	0	0	0
	31	0	0	0	0	0	0
Aug.	7	35	36	35	36	35	37
	10	82	8	14	18	22	27
	17	132	29	37	55	63	79
	24	270	66	85	119	159	175
	31	390	112	153	170	183	215
Sept.	7	232	74	96	123	145	156
	14	160	32	42	63	87	103
	21	99	17	23	34	52	64
	28	0	0	0	0	0	0
Percent reduction	After 3 days	0	90.5	82.9	78.7	73.2	68.9
	After 17 days	0	76.2	68.5	57.2	41.1	38.9
	After 37 days	0	80.6	73.8	61.7	45.6	39.1

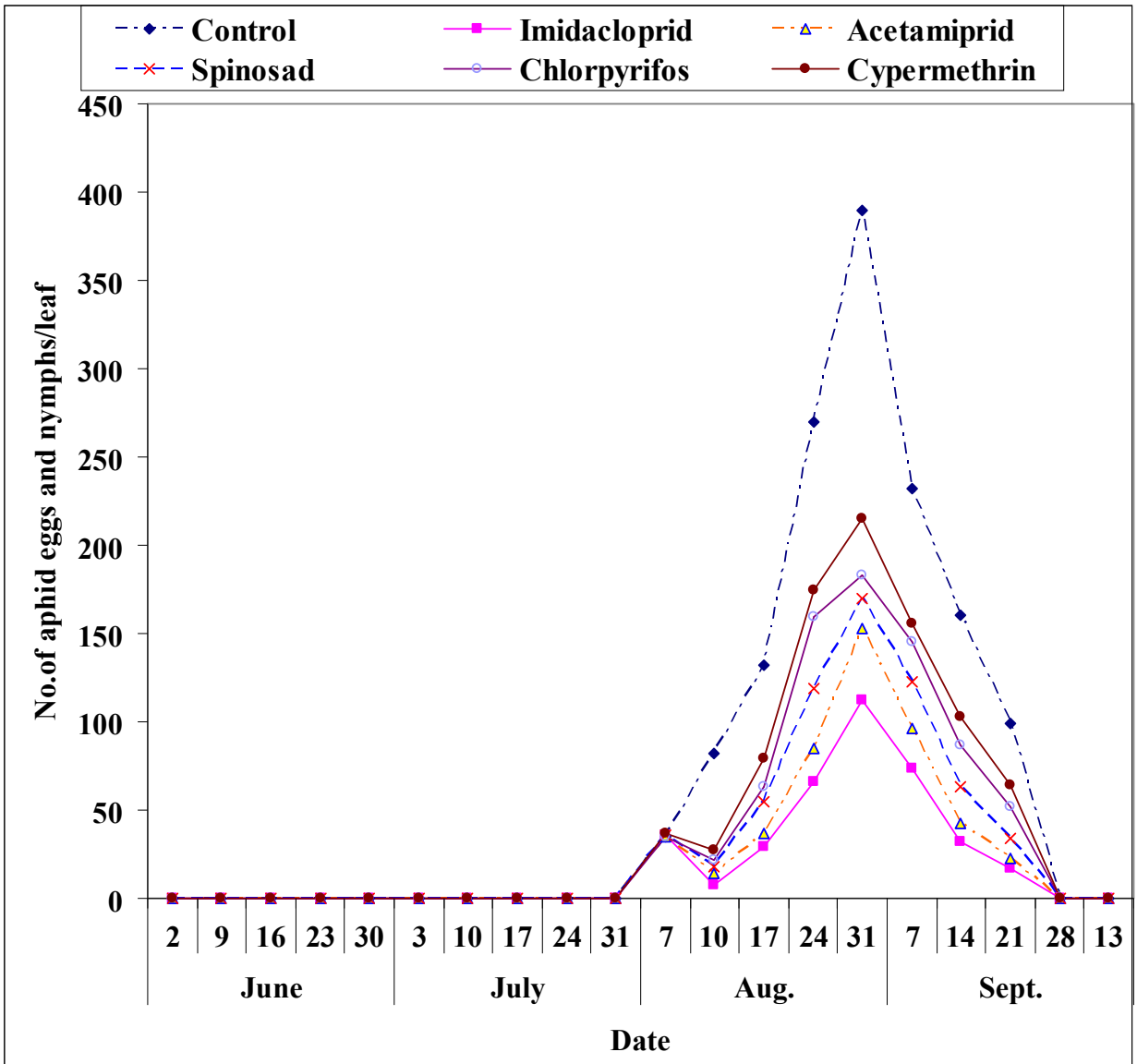


Fig.(3):Effect of some insecticides on the eggs and nymph population density of *S. graminum* on Horus plants in 2009 season.

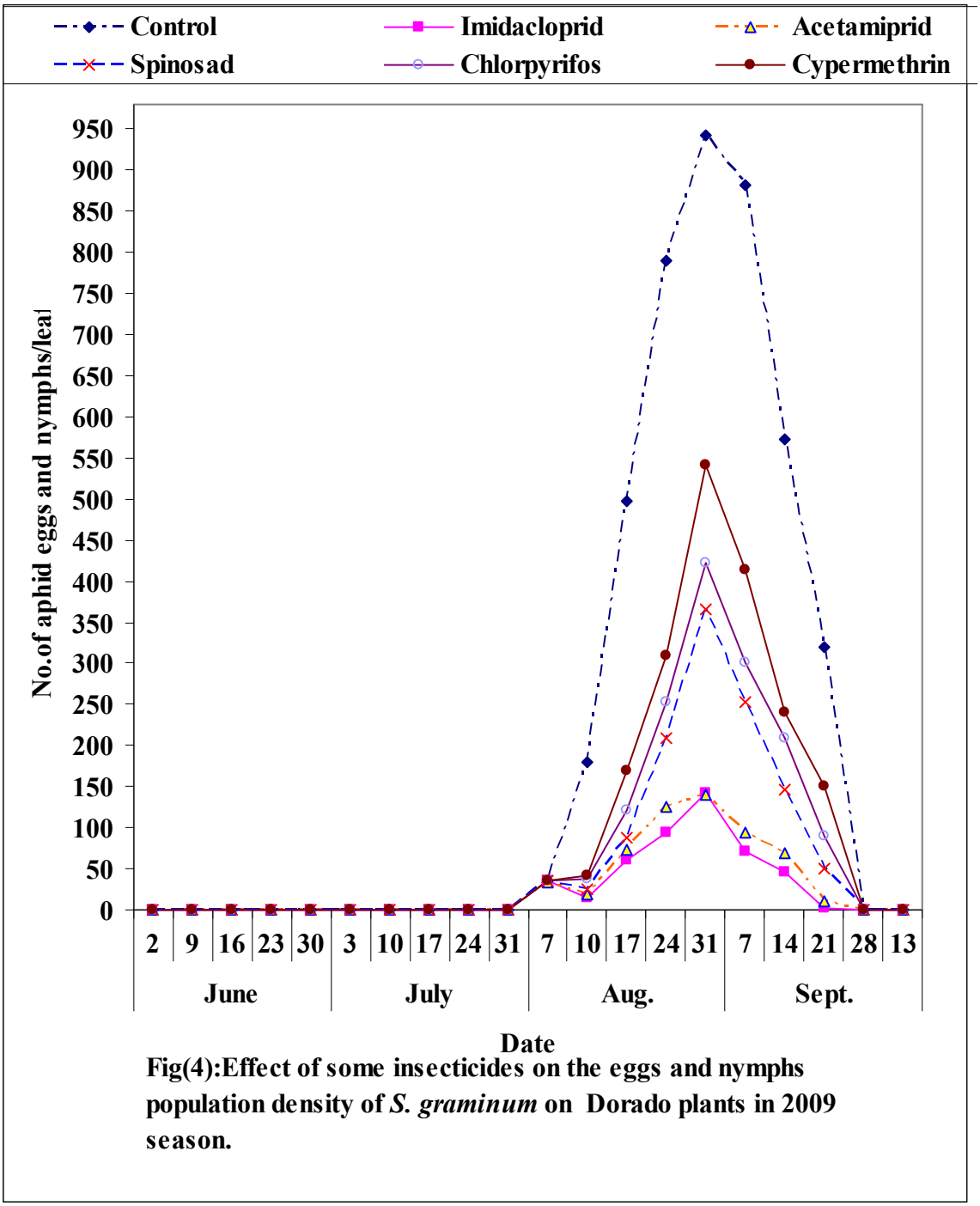
4-Effect of the second spray with the tested insecticides on the population density of *S. graminum* on Dorado plants in 2009 season.:-

Effect of the second spray with the tested insecticides on the egg and nymph populations of *S. graminum* on Dorado plants are presented in Table 4 and Fig. 4. Data indicated that the number of aphid were nearly the same in all the treatments before application with insecticides in 2009. The nymph population was decreased in all treated plots after 3 days of application with the tested insecticides compared with control. The activity of the tested insecticides were arranged in descending order as imidacloprid, acetamiprid, spinosad, chlorpyrifos and cypermethrin after 3 days from treatment, the reduction percent were 91.9, 89.13, 86.11, 79.48 and

77.31 percent, respectively, and after 17 days of spraying were 88.6, 83.6, 73.5, 68.9 and 61.8 whereas, after 37 days of application the reduction percent were 92.0, 87.4, 74.3, 64.3 and 59.2%. In general, the new insecticides were more effective than the conventional insecticides in controlling aphids on sorghum plants. These results are in agreement with the finding of **Gray et al., (1996)** who found reduction in cereal aphid infestation in the imidacloprid treated oats and wheat fields. Imidacloprid was effective as a seed treatment for 3-4 weeks after planting against the *R. maidis* and *S. graminum* on the sorghum hybrids. **Lacombe (1999)** stated that acetamiprid is a new neurotoxic insecticide from the chloronicotinyl family. At low rate, it has rapid and long activity, even on resistant insects, adults, larvae and eggs. A high systemic and translaminar action ensures effective control of sucking insects (especially aphids and white flies) and some Lepidoptera (especially leaf miners) and Coleoptera. It has a low toxicity to mammals, aquatic organisms and wild life and does not show adverse effects on honeybees or bumblebees. **Thompson and Hutchins (1999)** found that spinosad has rapid contact and ingestion activity insects causing excitation of the nervous system, leading to cessation of feeding and paralysis. Spinosad provides effective control of Lepidopteran, Dipteran and Thysanopteran pests and some Coleopteran and Orthopteran species. There is no reported phytotoxic activity of spinosad based products. **Maienfisch *et al.* (2001)** reported that, the neonicotionid insecticides have little contact activity and are most effective when ingested. **Natwick (2001)** decided that, translaminar movement is also an important attribute that allows the insecticide to control pests on both the sprayed leaf surface and the opposite side. This is important when treating pests such as aphids and whiteflies that live and feed predominantly on the underside of leaves. Having characteristics such as systemic and translaminar activities makes the neonicotinoids particularly effective on sucking pests such as aphids, leafhoppers, and whiteflies.

Table (4).Effect of the second spray with the tested insecticides on the population density of *S. graminum* on Dorado plants in 2009 season.

No.of aphid eggs and nymphs/leaf							
Month	Day	Control	Iimidacloprid	Acetamiprid	Spinosad	Chlorpyrifos	Cypermethrin
June	2	0	0	0	0	0	0
	9	0	0	0	0	0	0
	16	0	0	0	0	0	0
	23	0	0	0	0	0	0
	30	0	0	0	0	0	0
July	3	0	0	0	0	0	0
	10	0	0	0	0	0	0
	17	0	0	0	0	0	0
	24	0	0	0	0	0	0
	31	0	0	0	0	0	0
Aug.	7	35	36	34	35	36	36
	10	180	15	19	25	38	42
	17	497	60	73	87	121	169
	24	790	93	126	209	253	310
	31	943	143	139	365	423	542
Sept.	7	881	72	93	253	300	413
	14	572	47	70	147	210	240
	21	320	3	10	50	90	150
	28	0	0	0	0	0	0
Percent reduction	After3 days	0	91.9	89.1	86.1	79.5	77.3
	After17days	0	88.6	83.6	73.5	68.9	61.8
	After 37days	0	92.0	87.4	74.3	64.3	59.2



Fig(4):Effect of some insecticides on the eggs and nymphs population density of *S. graminum* on Dorado plants in 2009 season.

Conclusion

Rhopalosiphum maidis (Fich) and *Schizaphis graminum* (Rondani) started to infest the two sorghum varieties, Horus and Dorado by the last week of June and continue till the first half of August. While *Schizaphis graminum* started to infest both sorghum varieties by the first week of August and continue till the third week of September. Due to the results of the present study, imidacloprid was the recommended insecticide against of *Rhopalosiphum maidis* and *Schizaphis graminum* in sorghum fields.

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تاثير بعض المبيدات على خفض تعداد نوعين من المنّ روبالوسيفم ميدز وشيذوفس جرامنيم على صنفى الذرة الرفيعة حورس ودورادو

ربيع على إمام على[1] والأستاذ الدكتور عبد الرووف محمد الغريب[2] والأستاذ الدكتور سمير حسن مناع[2] والأستاذ الدكتور شعبان محمد عبد العال[1]

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الملخص

أجريت هذه التجربة في مزرعة كليه الزراعة جامعه الأزهر بأسيوط لتقييم فاعليه خمس أنواع من المبيدات وهى الاسبينوساد والسيبرمثرين والدروسبان والاسيتامبيرد والاميدوكلوبيردعلى مكافحه نوعين من المنّ وهم منّ الذرة روبالوسيفم ميدز ومنّ النجليات شيذوفس جرمانيم على صنفين هجين من الذره الرفيعة حورس كصنف قصير و دورادو كصنف طويل وذلك في موسم 2009.وفى هذه التجربة ظهر منّ الذرة أولا ثم ظهر بعد ذلك منّ النجيليات وتم رش المبيدات عند ظهور الاصابه بمنّ الذرة وكانت الرشة الأولى على نباتات الذرة والرشة الثانية عند ظهور الاصابه بمنّ النجليات .تم عد بيض وحوريات المنّ قبل الرش بيوم وكذلك بعد الرش بثلاث أيام ثم بعد الرش سبعه عشر يوما وأيضا في نهاية الموسم بعد سبعه وثلاثين يوما بعد الرش.حدث خفض فى تعداد المن بدرجه كبيره بعد ثلاث ايام من الرش وكان ترتيب المبيدات فى الخفض كالتالي الاميدوكلوبيردثم الاسيتامبيرد ثم الاسبينوساد ثم الدروسبان وأخيرا السيبرمثرين. انخفضت نسبه الخفض للمبيدات بعد سبعه عشر يوما وكان ترتيب المبيدات فى الخفض كما كانت بعد ثلاث ايام. أعلى نسبه خفض كانت بعد سبعه وثلاثين يوما وكان ترتيب المبيدات في درجه الفاعلية مثل ترتيبها بعد ثلاث أيام من ناحية الفاعلية. وبذلك يمكن استخدام الاميدو كلوبيرد فى مكافحه النوعين من المنّ على صنفي الذره الرفيعة حورس ودورادو.