PERFORMANCE OF CERTAIN GROUND AND AERIAL APPLICATION TECHNIQUES AGAINST PIERCING AND SUCKING INSECTS IN COTTON CULTIVATIONS

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Abstract

Eleven techniques represented almost spraying and dusting application methods common in Egypt were tested to control sucking insects on cotton cultivations by using certain insecticides recommended from Ministry of Agriculutre in Egypt. These insecticides were Deltanet, Prempet, catabron and Sulfur during seasons 1993, 1994. In the early season, three types of ground spraying equipment were used. These sprayers are semco, Tapa, CP-3 sprayed as target and drift spraying technique by using Deltanet against aphid. The target spray revealed 98-100% reduction in number of insects with the comprarison of drift spray technique which caused 75% reduction.

The season remain, the used techniques were categorized into three groups according to their capabilities in the mentioned respects as good, moderate and improper techniques for controlling sucking insects in cotton plantations.

A. The first group (Good techniques): Deltante and prempet caused 80% reduction from population insects by using semco sprayer and CP-3 sprayer as target spraying techniques. The droplet spectrum ranged between 15-58 droplets/cm2 with diameter 65-100 μm (VMD). The percentage of spray lost on ground was 25% from the total spray volume.

B. The second group (Moderate techniques): Deltanet caused 77% reduction from population insects by using semco, CP-3 and conventional sprayer. Although there was not droplets on lower surfaces of cotton plants could be observed, but might be settling droplets less than 25 μm. Produced by conventional sprayer which could not be counted through measuring technique used.

Catabron insecticide (unrecommended against sucking insects) revealed 50% reduction from insect populations by using semco sprayer, while the same insecticide revealed 60% reduction from insect population by using helicopter. The percentage of spray lost on ground was 44% for ground equipment as target spraying technique and helicopter.

C. The third group (Improper techniques): Three insecticides caused 12-47% reduction from insect population by using conventonal sprayer, and 43% was lost spray on ground from the total spray of the mentioned sprayer, but in case of sulfer dust by ground equipment or helicopter a 32% reduction from population insects was done with the same level mentioned for spray lost on ground. Generally, it was recommended to apply Deltanet insecticide which has a spectrum of droplets within 65-100 micrometers (VMD) in numbers not less than 15 droplets/cm2 on the lower sides of leaves with enough distributional homongenity.

INTRODUCTION

Cotton, being particularly attractive to pests traditionally received by for the highest number of treatment per season, thus exerting intensive selection perssure on all insects present, primary as well as secondary targets. Sucking insects were considered secondary pests in the seventies due to the general usage of OP'S against bolloworms and cotton leaf worms, which kept them in a minor role, but selection gradually produced resistance strains. Also, misapplication was responsible about attaining unsatisfactory pest control operation. In Egypt, the infestations of sucking insects to cotton plants usually starts in the early season during April, but their population was much higher during July and September (Samy 1963), Hassanien *et al* (1971). Now, the chemical control of sucking insects in cotton plantations could be considered as one of the essential tools in this concern, through the frame of the integrated pest management.

In Egypt majority of interest was directed to the type, dosage ..... ect of insecticides used, while a lesser attention was given to the application methods. A comparative study on the efficiency of certain ground sprayers was carried out by Afifi (1971), Womac, *et al* (1989) and Hindy (1992), who recorded significant variation in the deposit due to different arrangement of the nozzles, spray technique and rates of application. This work concentrates on studying the main spraying and dusting techniques applied either by ground machine or by aircraft at Sharkeya/ Gharbeya Governorates. Trails were done during early, mid and late cotton seasons (April-July-September), 1993-94, using various insecticides recommended by the Ministry of Agriculture. Appraisal of the tested techniques was carried out with the use of qualitative and bilogical assessments in order to spot lights on its bioefficiency and environmental side effect during various cotton ages.

MATERIALS AND METHODS

The Application techniques tested

A. Ground spraying

1. Semco sprayer: applying target spray at 6.0 lit./fed. semco co. Ltd., Osaka, Japan.
2. Semco sprayer: applying drift spray at 2.3 lit./fed.
3. CP-3 sprayer: applying target spray at 22.0 lit./fed. cooper pegler Co.

4. CP-3 sprayer : applying drift spray at 18.0 lit./fed. Ltd. West sussex, U.K

5. TAPA sprayer: applying semi-drift spray at 13.0 lit./fed. Tifa Co. Ltd.

6. TAPA sprayer: applying semi-drift spray at 23.0 lit./fed. Millington U.S.A.

7. TAPA Sprayer: applying semi-drift spray at 27.0 lit./fed.

8. Conventional sprayer applying target spray at 227.0 lit./fed. Local manifacture Egypt.

B. Ground dusting

9. Arimitsu duster (GMD-503L): applying target dust at 10.0 kg/fed. Arimitsu industry Co. ltd. Japan.

C. Aerial spraying

10. Mi-2 helicopter: applying target spray at 10.0 lit./fed. Mikhail Mil U.S.S.R. Owend by the state of Ukrania.

D. Aerial dusting

11. Mi-2 helicopter: applying target dusting at 10.0 kg./fed.

The Used Insecticides and dosages

1. Deltanet 40% EC. (Furathio carb): full, and quarter of the recommended dose (0.400 lit/fed.);

2. Catabron (mixture of curacron-profenofos-47.3% and I.G.R. 2.6%): half recommended dose (0.750 lit./fed.);

3. Prempet (mixture of : Meothrin-Fenpropathrin-and Admiral (IGR)- Pyriproxyfen: full dose (0.300 lit./fed.);

4. Sulfur: full recommended dose of agricultural sulfur powder (10.0 kg/fed.).

Methods of determination and evaluation of the tested application techniques

1. Qualitative technique for spray coverage: By means of Bendakote cards mounted on three levels of cotton plants and metalic receptors plus one card on a wire holder positioned in ground between plants. (Hindy 1989). The used dyes were Nigrosine (0.01%) at early season and crystal violet (0.01%) (plus 40 ml of vingar per litre - as recommended by the Ministry of Agriculture in order to acidify the

liquid) at mid and late seasons trials.

Dyed spots were counted and measured by the monocular lens "struben" having a magnification of x 15. Data were corrected (on basis of the spread factor) and calculated to obtain the VMD and N/cm2. The size measuring accuracy is ± 25 micrometers. (Anonymous 1978) and (Ciba Geigy 1990).

2. Qualitative technique for dust coverage: By means of a blackrough cards, at same distributional arrangement. The sulphur particles were counted and measured by the stuben lens. Figures 1, 2 and 3 shows the spray/dust coverage on cotton plant and that lost on ground using various ground & aerial application techniques.

3. Bioassay technique: Levels of infestation of aphids, whiteflies and jassid to cotton plants were determined on 25 plants selected at random forming the longest cross lines, inside each experimental plot. In mature plants, insects were counted on top, middle and bottom levels of the observed plants. According to the economic thershold of cotton pest's in Egypt El-Hamakey *et al* (1993), cotton fields infested with the following minimum number of individuals/colonies should be subjected to chemical application:

Aphid: At early season, seven colonies per seedling (two leaves of about 20 cm2 area) with 7-10 individuals/colony and 15 colonies/leaf of mature plant;

Jassid & whitefly: Ten nymphs and/or adults per one leaf of cotton plant. Counts were performed with the use of magnifying glass (X10) eight times immediately before application, one day after application and then 3,5,7,9,11 and 14 days, successively. Records were corrected by Henderson & Telton (1955) equation and were subjected to analysis of variance.

RESULTS AND DISCUSSION

The efficiency of the tested techniques was evaluated qualitatively with kowledge of the deposited spectrum of the insecticide spray droplets on cotton plants, specially on lower surfaces of plants levels, the preferable habitate of the target insect and biologically on basis of reduction of piercing and sucking insects infestation in cotton fields. It is worthy to mention that the relationship and correlation between spray quality and bioefficacy of toxic chemicals on piercing and sucking insects was not given the sufficient attention in the literature and in Egypt, in particular. Data

presented in Table 1 indicated the presence of quite high numbers of aphids on upper, middle and lower parts of cotton plants ranging from 10-30 individuals/cm2 in the untreated plots during both seasons. However, considerable numbers of whitefly nymphs, ranged between 12-24 nymphs/cm2 were recorded on the upper, middle and lower parts of cotton plants during the late season of 1993 and the mid season 1994. Jassid infestation ranged between 2-3 individuals/cm2 in both seasons. This finding may give confidence to the experimental results.

Table 1 indicates the mean number of insects/cm2 counted on the lower surface of cotton leaves before spraying, as an approximate structure model of infestation. Figures 1-9 demonstrates the initial and residual activities of the tested application techniques against aphid, jassid and whitefly during early, mid and late seasons:

The tested application techniques colud be arranged in descending order on basis of the obtained spray quality and the bioassay results, as follows:

The tested techniques could be categorised into three groups according to the obtained mean percentages of reduction of the treated insects, as follows:-

First group (A): more than 80%, as good techniques.

Second group (B): 50% -80%, as moderate techniques.

Third group (C): less than 50%, as improper techniques.

It seems that the tested insecticides could be arranged in descending order, according to their effect on the treated insects, on cotton, within the criteria of this work, as follows:-

Deltanet-Prempet-Catabron-Sulfur powder.

At early season, the percentage of aphids reduction ranged 74% - 100% using full dose of deltanet with different ground sprayers, various spray types and rates of application (2.3-27.0 lit./fed.). The percentage of spray lost on ground represented 16-34% from the total bulk. Concerning the spectrum of droplets deposited on the lower surface of seedling leaves, a number of 20-132 droplets sized between 50 and 102 micrometers (VMD) was recorded.

On the other side, the mean number of aphid counted on this target was 7 individuals /cm2.

Data in Table 2 indicate that the role played by the tested techniques might be considered as a secondary role after the type and dosage of the selected insecticide which was the dominant factor affecting aphid control on seedlings.

At mid and late seasons of cotton growth, a considerable role was played by the tested application techniques, beside the traditional influence of toxic chemicales. For example, using a full dose of deltanet insecticide with Semco sprayer at 6.0 lit./fed. and conventional sprayer at 227.0 lit./fed. caused 100% and 12% reduction of insect, respectively, which emphasizes the spraying technique role.

In the first group which classified as GOOD TECHNIQUES, Semco (6.0 lit./fed.) and CP-3 (22.0 lit./fed.) were tested as target sprayers, with deltanet and prempet insecticides, and gave 100% reduction (for deltanet) and 84% (for prempet). The droplet spectrum was 15-58 droplets of 64-96 μm (VMD) per square centimeter of cotton leaves.

The spray lost on ground between plants represented 13-39% from the total spray,

In the second group which considered as MODERATE TECHNIQUES ground and aerial spraying techniques were included. Semco (2.3 lit./fed.) and CP-3 (18.0 lit./fed.) were tested as drift sprayers with deltanet insecticide and gave a close percentage of 77% reduction of treated insects. The droplet spectrum ranged 6-18 droplets of 73-110 μm/cm2 and the amount lost on ground was approximately 48%.

Semco sprayer (6.0 lit./fed.) caused 52% insects reduction with half dose of catabron insecticide and 12 droplets of 96 μm/cm 2. Mi-2 helicopter sprayed half dose of catabron caused more reduction (60%) of insects with a spectrum of 21 droplets of 245 μm/cm2.

The unexpected result of mortality was given by the conventional sprayer (227 lit./fed.) using deltanet insecticide, where no droplets were recorded on the lower surface of cotton leaves at mid season. Such a result might be attributed to the influence of fine droplets (less than 25 μm) which could not be counted. The mean percentage of spray lost on ground by means of the tested techniques was 40%, except for CP-3 sprayer which caused 57% loss.

The last group of IMPROPER TECHNIQUES included some ground sprayers and dusting techniqe either by ground or aerial means. In spite of spraying catabron in-

secticide with CP-3 sprayer at 22.0 lit./fed., 48% reduction of insects was obtained with a little number of droplets (8 droplets/cm2) of 77 micrometers.

By means of conventional sprayer-having no deposit on lower surface leaves-47% and 37% insect's reduction were obtained using prempet and catabron insecticides, respectively.

A close reduction of 32% was obtained with Arimitsu duster and Mi-2 helicopter/dusting version, applying agricultural sulfur powder, at 10 kg/fed. The spectrum of particles deposits on lower surface of cotton leaves ranged 52-77 particles sized 10-90 μm. The lowest reduction of treated insects (12%) was given by the conventional sprayer with the use of deltanet insecticide, during late season.

The general means of losses of spray/dust on ground were 31% and 43% for (TAPA/Semco/CP-3) and conventional sprayer /Mi-2 helicopter, dust/Arimitsu duster, respectively.

On basis of the obtained data, the optimum size of droplets recommended for controlling insects of cotton could be ranged between 65 and 100 micrometers (VMD) with numbers not less than 15 droplet/cm2 on the lower side of leaves of all plant levels, taking into consideration a suitable distributional homogeneity. These results seem to be similar to such results mentioned by Smith and Goodhue (1942), Himel (1969), Gabir *et al* (1991) and Hindy (1992).

Table 1. General mean number of insects/cm2, counted on the lower surface of cotton leaves before spraying.

Season	early Seedling	1993						early Seedling	1994					
		Mid			Late				Mid			Late		
Level		upper	Middle	lower	upper	Middle	lower		upper	Middle	lower	upper	Middle	lower
aphid	7	23	15	13	16	12	10	0	30	26	21	0	0	0
Jassid	0	2	2	2	2	2	2	2	3	2	2	0	0	0
Whitefly	0	0	0	0	12	12	12	0	24	19	17	0	0	20

Table 2. Illustrated spray coverage, percent reduction of aphids and the percent losses on ground at cotton seedlings as produced by certain ground equipments at early season with Deltanet insecticide.

Sprayer	% reduction of aphids	Spray type	Spraying volume (lit./fed.)	Droplets (N/cm2/VMD)	% losses on ground
1. Semco	100	target	6.0	53/50	26
2. TAPA	100	Semi-drift	13.0-27.0	132/102	29
3. CP-3	98	target	22.0	20/74	34
4. Semco	76	drift	2.3	23/85	16
5. CP-3	74	drift	18.0	61/71	17

Table 3. Illustrated spray coverage, percent reduction of sucking insects and the percent of losses on ground at mid and late seasons as produced by certain aerial and ground equipments with different insecticides.

Group	Serial No.	Sprayer	Reduction (%)	Spray vol. (Lit.fed.)	Spray (1) type	Insect (2)	Season	Drops(3) (ND)	Losses (4) (%)
A	1	Semco	100	6.0	T	Dlt.	mid	58/96	39
	2	CP-3	100	22.0	T	Dlt.	mid	15/64	32
	3	Semco	85	6.0	T	Prm	late	17/68	21
	4	Cp-3	82	22.0	T	Prm.	late	17/90	13
B	5	Conv.	78	227.0	T	Dlt.	mid	00/00	44
	6	Semco	77	2.3	D	Dlt.	late	9/73	39
	7	CP-3	76	18.0	D	Dlt.	late	18/110	57
	8	Mi-2	60	10.0	T	Ctb	mid	21/245	43
	9	Semco	52	6.0	T	Ctb	mid	12/96	33
C	10	CP-3	48	22.0	T	Ctb.	mid.	8/77	25
	11	Conv.	47	227.0	T	Prm.	late	00/00	50
	12	Conv.	37	227.0	T	Ctb.	mid	00/00	35
	13	Mi-2	34	10.0*	T	Slf.	mid	77/16-90	42
	14	Arimitsu	30	10.0*	T	Slf.	mid	52/10-90	44
	15	Conv.	12	227.0	T	Dlt.	late	00/00	44

Notes:

1. T: target spray; D: drift spray.
2. Dlt.: Deltanet; Prm.: Prempet; Ctb.: Catabron; Slf.: Sulfur
3. Spectrum of droplets/particles deposited on lower surface of cotton leaf N: Number/Cm2, D: Size of droplet (VMD)/ Particle, micrometer.
4. Percentage of spray lost on ground

(*) kg/fed.

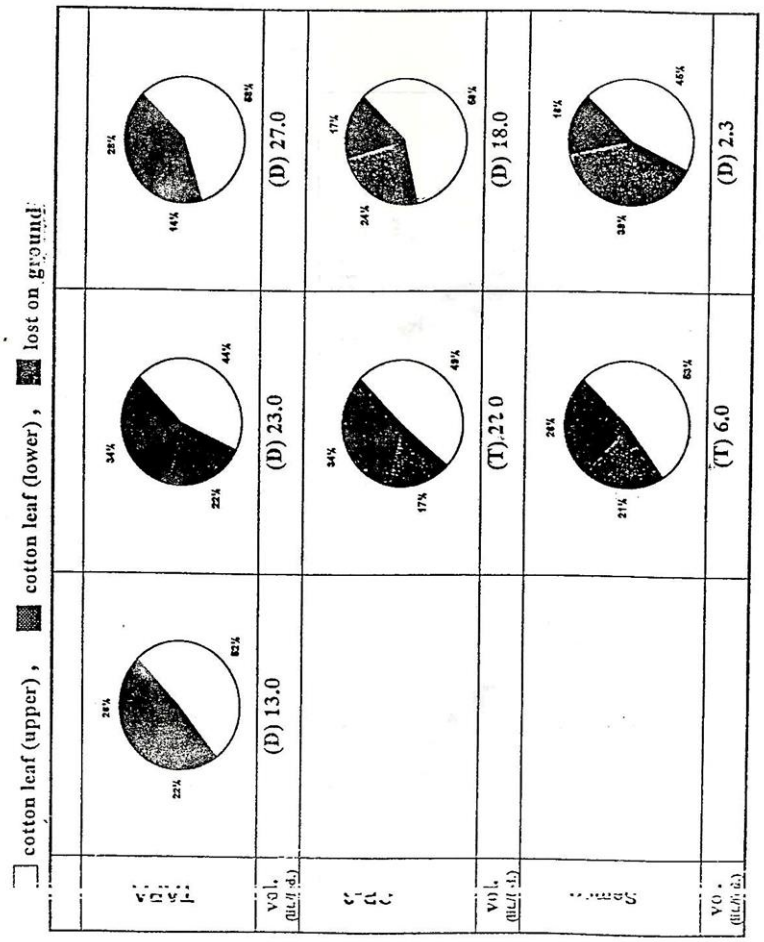


Fig. 1. Spray coverage on cotton seedlings and spray lost on ground as produced by certain ground equipment at early season 1993 using full dose of Deltanet insecticide.

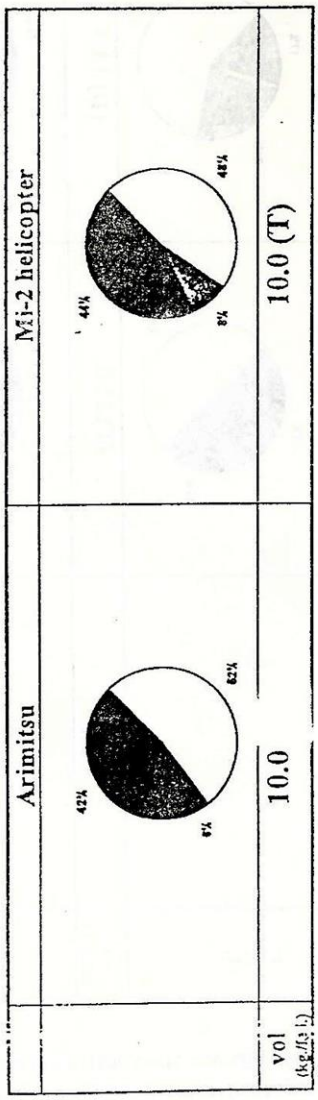
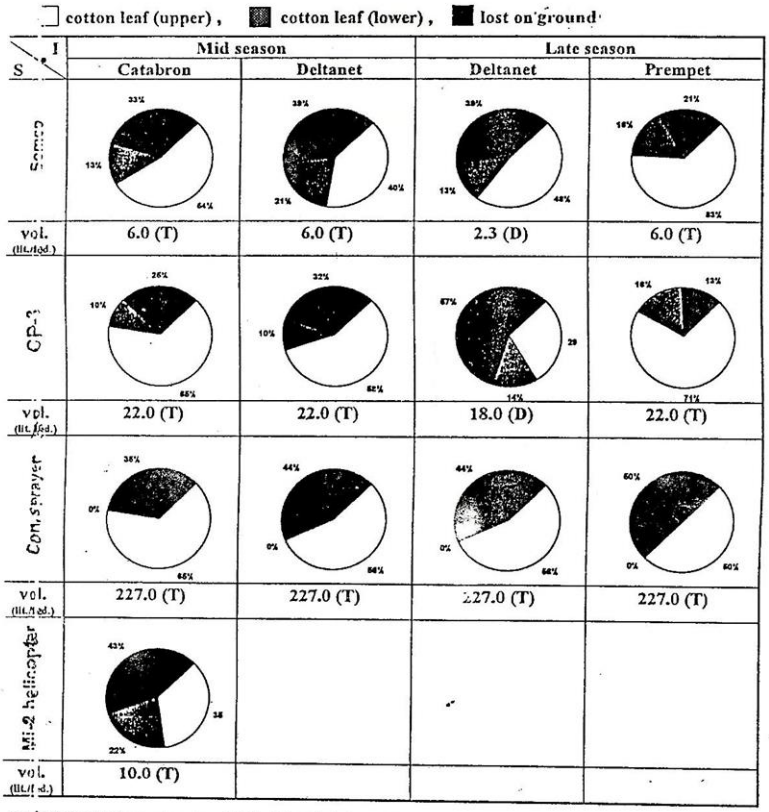


Fig. 2. Dust coverage on cotton plants and dust lost on ground as produced by ground duster "Arimitsu" and (Mi-2) helicopter "dusting version", at 10 kilogram sulfur per feddan.



D: drift, T: target; vol. : spraying volume, lit./fed. ; I: insecticide; S : spraying technique .

Fig. 3. Spray coverage on cotton plants and spray lost on ground, as produced by certain ground and aerial spraying applications at mid & late seasons (1993/94) using different insecticides.

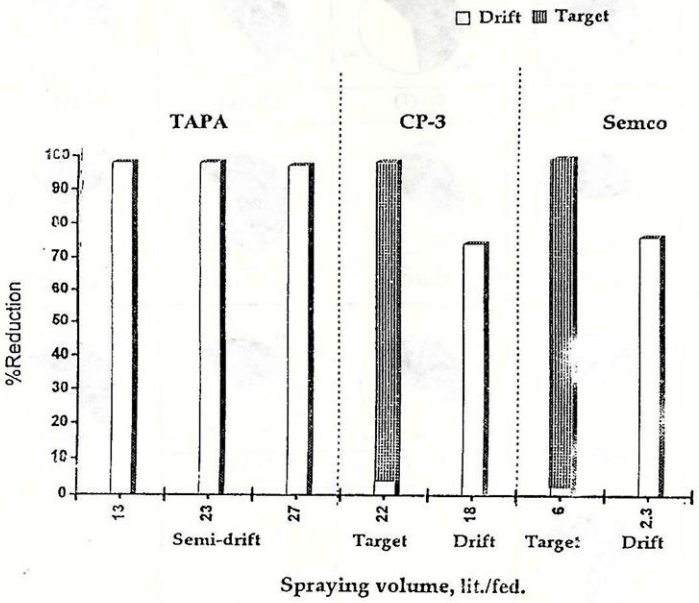


Fig. 4. Mean of initial and residual activities of Deltanet against aphids during early season 1993 with the use of ground spraying techniques.

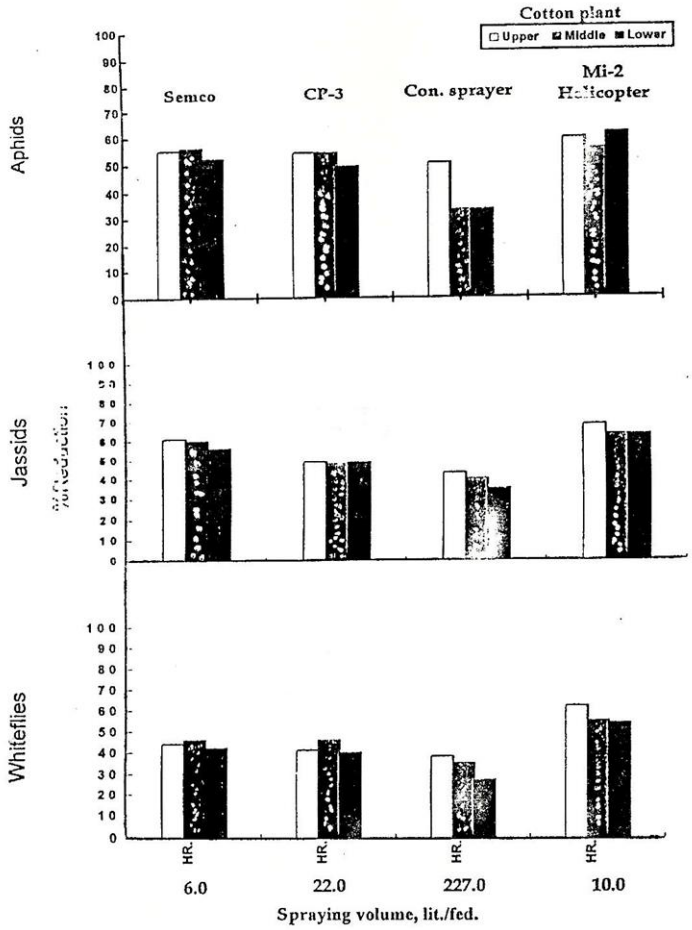


Fig. 5. Mean of initial and residual activities of Catabron against sucking insects during mid season 1994 with the use of ground and aerial application techniques (target spray).

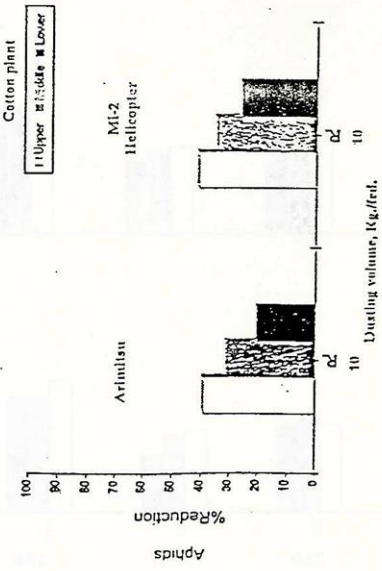


Fig. 6. Mean of initial and residual activities of Deltanet against aphids and jassids during mid season 1993 with the use of various ground application techniques (target spray).

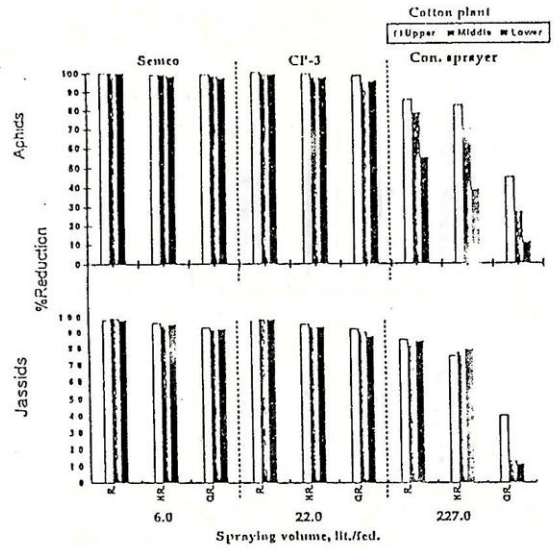


Fig. 7. Mean of initial and residual activities of agricultural sulfur powder against aphids during mid season 1994 with the use of ground and aerial application techniques (target spray).

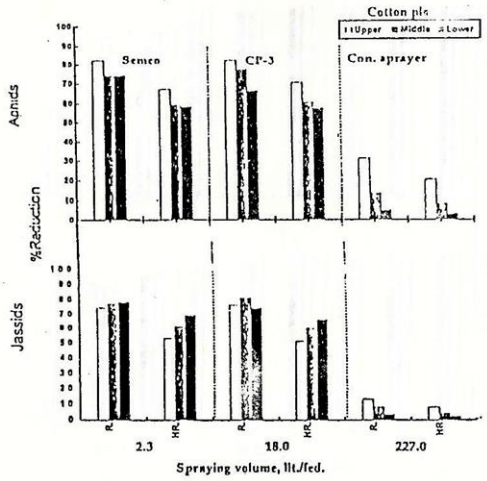


Fig. 8. Mean of initial and residual activities of Deltanet against aphids and jassids during late season 1993 with the use of various ground application techniques.

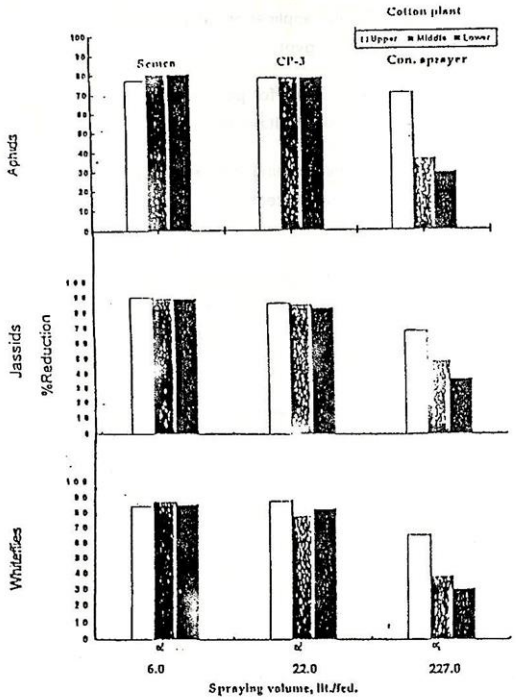


Fig. 9. Mean of initial and residual activities of Prempet agalnst sucking insects during late season 1993 with the use of various ground application techniques (target spray).

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دراسات مقارنة بين بعض تقنيات التطبيقات الأرضية والجوية ضد الحشرات الثاقبة الماصة باستخدام المبيدات الحشرية علي القطن

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تم إختبار إحدي عشرة تقنية تمثل غالبية طرق الرش والتعفير شائعة الاستعمال في مصر لمكافحة المن والجاسيد والذباب الأبيض في زراعات القطن وذلك باستخدام بعض المبيدات الحشرية الموصي بها من قبل وزارة الزراعة في مصر وهي الدلتانيت والبرمبيت ومسحوق الكبريت الزراعي بالاضافة إلي مبيد الكاتابرون خلال موسمي ١٩٩٣ ، ١٩٩٤.

في بداية الموسم إستخدمت ثلاثة أنواع من الرشاشات الارضية وهي سيمكو، تابا، سي بي - ٣ بأساليب الرش الهدفي والانجرافي لمبيد الدلتانيت ضد المن حيث تأكد تفوق الرش الهدفي محققا ٩٨ - ١٠٠ ٪ خفضا في اعداد الحشرات مقارنا بالرش الانجرافي الذي سبب خفضا في حدود ٧٥٪.

أما باقي الموسم فقد تم تصنيف التقنيات المستخدمة إلي ثلاثة مجموعات تبعا لمتوسط النتائج الحيوية لخفض أعداد حشرات المن والجاسيد والذباب الأبيض علي القطن.

المجموعة الأولي أ. (تقنيات فاعلة): سببت خفض في إعداد الحشرات يزيد علي ٨٠٪ شملت الرش الارضي الهدفي للرشاشتين سيمكو وسي بي ٣ باستخدام كل من الدلتانيت والبرمبيت. تراوح طيف القطرات بين ١٥ - ٨٥ قطرة علي السنتيمتر المربع ذات قطر متوسط ٦٥ - ١٠٠ ميكرون (متوسط حجمي) وكانت نسبة الفاقد علي التربة بين النباتات حوالي الربع من جملة الرش.

المجموعة الثانية ب . (تقنيات متوسطة) : باستخدام الدلتانيت تحقق خفض في اعداد الحشرات بنسبة ٧٧٪ تقريبا للرشاشات الارضية سيمكو وسي بي ٣ كذلك الرشاشة التقليدية ، التي لم يسجل فيها أي قطرات علي السطح السفلي للاوراق ويمكن ان تعزي هذه النتيجة إلي ان الرشاشتين سيمكو وسي بي ٣ قد إستخدمتا لإنتاج رش إنجرافي بينما استخدمت الرشاشة التقليدية في إنتاج رش هدفي علي النباتات. إن خلو الاسطح السفلية للاوراق لايعني عدم وصول قطرات الرش بالكامل ولكن يحتمل وصول قطرات دقيقة تقل احجامها عن ٢٥ ميكرون باستخدام الرشاشة التقليدية لم يتم رصدها من خلال تقنية القياس المستخدمة. حققت الرشاشة سيمكو خفضا في اعداد الحشرات في حدود ٥٠٪ فقط وذلك لاستخدام مبيد الكاتابرون (غير موصي به ضد الحشرات الثاقبة الماصة). أما الطائرة الهليكوبتر فقد حققت خفضاً في حدود ٦٠٪ علي الرغم من استخدام نفس المبيد وهو مايدعم موقفها في حالة استخدام مبيد أفضل مثل الدلتانيت.

أما نسبة الفاقد بين النباتات فكانت حوالي ٤٤ ٪ للرشاشات الارضية ذات اسلوب الرش الهدفي والطائرة الهليكوبتر.

المجموعة الثالثة جـ. (تقيات غير مناسبة) : حققت الرشاشة التقليدية خفضاً في أعداد الحشرات في حدود ١٢ – ٤٧٪ باستخدام ثلاثة مبيدات مختلفة وكانت نسبة الفاقد أيضاً في حدود ٤٣٪ أما إستخدام التعفير سواء بالعفارة الارضية أو طائرة الهليكوبتر فقد حقق خفضاً في اعداد الحشرات في حدود ٣٢٪ مع نفس المستوي السابق للفقد علي التربة.

وعلي وجه العموم يمكن القول أن الحجم النموذجي لقطرات الرش الممكن التوصية به عند مكافحة هذه الحشرات علي القطن يمكن ان يتراوح بين ٦٥ – ١٠٠ ميكرومتر علي ان لاتقل اعداد هذه القطرات عن ١٥ قطرة/سم٢ علي السطح السفلي لأوراق القطن مع الأخذ في الاعتبار التجانس المناسب في توزيع هذه القطرات.