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Efficacy of New Insecticidal Formulations as Seed Treatment Against Whitegrub in Groundnut*

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ABSTRACT

Field experiment was conducted at Gujarat Agricultural University, Sardar Krushinagar during 1997 to evaluate efficacy of quinalphos 25 EC (Ekalux 25 EC), quinalphos 20 AF (Ekalux 20 AF) and carbosulfan 25 EC (Marshal 25 EC) at 15, 20 and 25 ml/kg seeds as seed treatment against whitegrub in groundnut. The results revealed that all the insecticides proved safe as seed treatment as none of them adversely affected seed germination. Further, the new formulation i.e. quinalphos 20 AF (Ekalux 20 AF) @ 25 ml/kg seeds was adjudged as the best seed treatment against whitegrub in groundnut from view point of multiple ranking considering plant mortality, grub population and Net Insecticide Cost Benefit Ratio (NICBR). The next effective seed treatments were quinalphos 20 AF @ 20 ml, quinalphos 25 EC @ 25 and 20 ml/kg seeds. Corbosulfan 25 EC @ 25 ml/kg seeds was also effective against whitegrub but its NICBR was low.

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INTRODUCTION

Groundnut, *Arachis hypogaea* L. is a major *kharif* oil seed crop of India. Whitegrub, *Holotrichia consanguinea* Blanch. is the key pest of groundnut that inflicts 50 to 100 per cent loss in pod yield in Rajasthan, Gujarat and Punjab (Shah *et al.*, 1975; Yadava *et al.*, 1977 and Bakhetia, 1982). Efforts have been made to control whitegrub either through presowing soil application of granular insecticides like phorate and carbofuran (e.g. Yadava and Sharma, 1955) or through seed treatment with EC formulation of quinalphos, chlorpyriphos etc. (Bakhetia and Brar, 1983 and Patel *et al.*, 1995). However, in recent years, new formulation of quinalphos and carbosulfan i.e. Ekalux 20 AF and Marshal 25 EC have been introduced in market. It was therefore thought necessary to compare the efficacy of these new formulations with the conventional one against whitegrub as seed treatment in groundnut.

MATERIALS AND METHODS

Field experiment was conducted at Instructional Farm of Agronomy, C. P. College of Agriculture, Gujarat Agricultural University, Sardar Krushinagar during *kharif* 1997. Groundnut cultivar GG-2 was sown in Randomised Block Design in plots measuring 5.0 x 3.5 m. The trial was replicated thrice. Three insecticides viz., quinalphos 25 EC, quinalphos 20 AF (both

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from Sandoz India Ltd., now Novartis (India) Ltd., Mumbai) and carbosulfan 25 EC were tested at 15, 20 and 25 ml per kg seeds against whitegrub in groundnut. All the groundnut seeds were treated first with carbendazim 25 per cent S D @ 3 g per kg to prevent attack of seed and soil born pathogen and then one kg of seeds were treated separately for each treatment as per method described by Patel *et al.*, 1995. The germination test of treated seeds was also conducted by sandwitching treated seeds between two dics of blotting paper. Such test was conducted 1, 3, 7 and 10 days after seed treatment and per cent germination was worked out.

Total number of plants and plants killed due to whitegrub damage were recorded 30, 45, 60 and 75 days after sowing from net plot area in all the treatments. The damage plants were removed after each count. From these data, cumulative per cent plant mortality were computed. Pod and dry fodder yield was recorded from the net plot area separately for each plot at the time of harvest. After harvesting, grub population was recorded from one square meter area in each plot by digging soil upto 75 cm deep. Per cent avoidable loss in groundnut pod and fodder yield and increase in the yield in various treatments over control was computed using formulae suggested by Khosla (1977). Economics of various treatments was worked out considering market price of groundnut pod dry fodder, and the insecticides.

RESULTS AND DISCUSSION

Germination

The results of germination test conducted in laboratory condition clearly indicated that seed germination did not differ significantly when treated with chemical insecticides viz., quinalphos 25 EC, quinalphos 20 AF and carbosulfan 25 EC at 15, 20 and 25 ml dose as compared to germination was substantial (more than 75%) even 10 days after seed treatment in all the insecticidal treatments. Thus, quinalphos 25 EC as well as quinalphos 20 AF and carbofuran 25 EC proved safe as seed treatment for groundnut at all the three doses tested. In past, these insecticides have been found safe as seed treatment for groundnut (e.g. Anon., 1994 C and Patel *et al.*, 1995).

Plant mortality

The cumulative plant mortality of groundnut due to whitegrub was significantly low in all the insecticidal treatments irrespective of the dose (Table-1). The lowest plant mortality was recorded in the seed treatment of quinalphos 20 AF @ 25 ml per kg (12.05%) closely followed by quinalphos 25 EC at same dose whereas the untreated plots witnessed maximum plant mortality (50.71%). Thus, the new formulation of quinalphos i.e.; Ekalux 20 AF was as effective as its EC formulation against whitegrub in groundnut. Quinalphos 20 AF has been also found effective against whitegrub at Jaipur (Anon., 1994 C).

Grub population

The grub population after harvest of the crop was significantly less in all the seed treatments as compared to the grub population recorded in untreated plots (6.33 grubs/m^2). The lowest grub population was recorded in the treatments of EC as well as AF formulation of quinalphos in 25 ml dose.

from Sandoz India Ltd., now Novartis (India) Ltd., Mumbai) and carbosulfan 25 EC were tested at 15, 20 and 25 ml per kg seeds against whitegrub in groundnut. All the groundnut seeds were treated first with carbendazim 25 per cent S D @ 3 g per kg to prevent attack of seed and soil born pathogen and then one kg of seeds were treated separately for each treatment as per method described by Patel *et al.*, 1995. The germination test of treated seeds was also conducted by sandwitching treated seeds between two dics of blotting paper. Such test was conducted 1, 3, 7 and 10 days after seed treatment and per cent germination was worked out.

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TABLE 1

Efficacy of some newer formulations of insecticides as seed treatment against whitegrub in goundnut.

Sr. No.	Treatment	Dose (ml/kg seeds)	Germination (%) 10 days after treatment	Cumulative plant mortality (%) 75 DAS	Av. No. of grubs/m²	Yield (q/ha)	
						Pod	Dry fodder
1.	Quinalphos 25 EC	15	75.00	22.24 (28.14)*	3.00 (1.87)**	7.14	34.73
2.	Quinalphos 25 EC	20	80.00	17.24 (24.54)	1.66 (1.46)	12.00	40.08
3.	Quinalphos 25 EC	25	81.66	12.49 (20.70)	0.66 (1.05)	13.13	41.30
4.	Quinalphos 20 AF	15	75.00	23.40 (28.93)	3.00 (1.87)	7.37	35.07
5.	Quainalphos 20 AF	20	80.00	16.90 (24.28)	1.33 (1.34)	11.91	41.50
6.	Quinalphos 20 AF	25	78.33	12.05 (20.32)	0.66 (1.05)	13.33	44.36
7.	Carbosulfan 25 EC	15	83.33	23.04 (28.69)	4.33 (2.19)	6.46	34.13
8.	Carbosulfan 25 EC	20	76.33	19.93 (26.52)	2.33 (1.64)	8.98	39.38
9.	Carbosulfan 25 EC	25	76.33	19.20 (25.99)	2.00 (1.58)	9.38	40.02
10.	Control (Untreated)	–	75.00	50.71 (45.41)	6.33 (2.61)	4.19	21.22
	S.Em ±	– –	3.40	1.05	0.13	0.84	1.26
	C. D. at 5 %	– –	N. S.	3.11	0.38	2.51	3.74
	C.V. %	– –	7.45	6.62	13.36	15.58	5.68

1 DAS = Days after sowing.

* Figures in parenthesis are arcsin $\sqrt{\text{per cent}}$ transformed values.

** Figures in parentheses are $\sqrt{X + 0.5}$ transformed values.

The lowest dose of all the tree insecticides were less effective in crecking whitegrub population in groundnut (Table-1). Thus, the results largely corroborate the findings of earlier worker (Suthar, 1994).

Pod yield

Groundnut pod yield was significantly higher in all the seed treatments except the lowest dose of carbosulfan (15 ml/kg) than untreated plots. Among various seed treatments, quinalphos 20 AF 25 ml proved as the best treatments, quinalphos 20 AF 25 ml proved as the best treatment as it recorded the highest pod yield (13.33 q/ha) however, it was at par with similar dose of its EC formulation and 20 ml dose of either of these formulations (Table-1). Similar findings have been reported in past (Anon., 1994). Carbosulfan @ 25 ml per kg was another effective treatment (9.38 q/ha) and it was at par with its 20 ml dose and lowest dose of quinalphos AF as well as EC formulation. However, the lowest dose of carbosulfan 25 EC witnessed the lowest pod yield and was at par with untreated plots and thus, proved ineffective.

Fodder yield

The dry fodder yield (Table-1) was also significantly higher in all the seed treatments as compared to the control plots (21.22 q/ha). The highest dry fodder yield was recorded in the seed treatment of quinalphos 20 AF in 25 ml dose (44.36 q/ha) which was at par with its 20 ml dose and quinalphos 25 EC @ 25 ml dose. The next effective treatments included carbosulfan 25 EC at 25 and 20 ml dose with respect to fodder yield.

Increase in yield over control

The higest per cent increase in groundnut pod yield over control was observed in the treatment of quinalphos 20 AF 25 ml dose (218.13%) and it was closely followed by similar dose of quinalphos 25 EC (213.36%). The descending order of efficacy of seed treatments on the basis of per cent increase in pod yield over control was quinalphos 20 AF 25 ml > quinalphos 25 EC 25 ml > quinalphos 25 EC 20 ml > quanalphos 20 AF 20 ml> carbosulfan 25 EC 25 ml > carbosulfan 25 EC 20 ml > quinalphos 20 AF 15 ml > quinalphos 25 EC 15 ml> and carbosulfan 25 EC 25 ml > per kg seeds.

Similarly, the highest increase in dry fodder yield over control was also recorded in the treatment of quinalphos 20 AF 25 ml dose (109.04%) and it was closely followed by its lower dose i.e. 20 ml (95.57%) and quinalphos 25 EC 25 ml dose (94.62%). The descending order of efficacy of treatments on the basis of per cent increase in dry fodder yield over control was quinalphos 20 AF 25 ml > quinalphos 20 AF 20 ml > quinalphos 25 EC 25 ml > quinalphos 25 EC 20 ml > carbosulfan 25 EC 25 ml > carbosulfan 25 EC 20 ml > quinalphos 20 AF 15 ml > quinalphos 25 EC 15 ml > and carbosulfan 25 EC 15 ml per kg seeds.

Avoidable loss in yield

The highest avoidable loss in pod yield was recorded in untreated control plots (68.56%), followed by carbosulfan 25 EC 15 ml (51.53%), quinalphos 25 EC 15 ml (46.43%) and quinalphos 20 AF 15 ml per kg seeds (44.71%). Whereas, the lowest loss in pod yield was observed in the treatment of quinalphos 25 EC 25 ml (1.5%).

TABLE 2

Economics of various seed treatments against whitegrub in groundnut.

Sr. No.	Treatments	Total quantity of insecti-cide used (l/ha)	Cost of insec-ticides including labour charge (Rs/ha)	Average yield (q/ha)		Increase over control (%)		Avoidable loss in yield (%)		Net gain over control (Rs/ha)			Net profit (Rs/ha)	Net ICBR
				Pod	Dry fodder	Pod	Dry fodder	Pod	Dry fodder	Pod	Dry fodder	Total		
1.	Quinalphos 25 EC	1.2	494	7.14	34.73	70.4	63.7	46.4	21.7	3835	676	4511	4017	1:8.13
2.	Quinalphos 25 EC	1.6	646	12.00	40.00	186.4	88.9	9.9	9.6	10153	943	11096	10450	1:16.17
3.	Quinalphos 25 EC	2.0	798	13.13	41.30	213.4	94.6	1.5	6.9	11622	1004	12626	11828	1:14.82
4.	Quinalphos 20 AF	1.2	482	7.39	35.07	75.9	65.3	44.7	20.9	4134	693	4827	4345	1:9.01
5.	Quinalphos 20 AF	1.6	630	11.91	41.50	184.2	95.57	10.7	6.4	10036	1014	11050	11420	1:16.53
6.	Quinalphos 20 AF	2.0	778	13.33	44.36	218.1	109.0	–	–	11882	1157	13039	12261	1:15.75
7.	Carbosulfan 25 EC	1.2	648	6.46	34.13	54.2	57.4	51.3	23.1	2951	646	3597	2949	1:4.55
8.	Carbosulfan 25 EC	1.6	851	8.98	39.38	114.3	85.6	32.6	11.2	6227	908	7135	6284	1:7.38
9.	Carbosulfan 25 EC	2.0	1054	9.38	40.02	123.9	88.6	29.6	9.8	6747	940	7687	6633	1:6.29
10.	Control (Untreated)	–	–	4.19	21.22	–	–	68.6	52.2	–	–	–	–	–

Market price : Groundnut pod : Rs. 1300/quintal

Groundnut dry fodder : Rs. 58/quintal

Quinalphos 25 EC : Rs. 380/Litre

Quinalphos 20 AF : Rs. 370/Litre

Carbosulfan 25 EC : Rs. 508/Litre

Labour Charges : Rs. 38/day

TABLE 3

Multiple ranking for judging overall effectiveness of seed treatment in groundnut against whitegrub.

Sr. No.	Treatment	Dose (ml/kg seeds)	Cumulative plant mortality	Grub population per m^2	NICBR	Total rank	Alphabetic grade
1	Quinalphos 25 EC	15	22.24[7]	3.00[5]	1:8.13[5]	19	G
2	Quinalphos 25 EC	20	17.24[4]	1.66[3]	1:16.17[2]	9	D
3.	Quinalphos 25 EC	25	12.49[2]	0.66[1]	1:14.82[4]	7	C
4.	Quinalphos 20 AF	15	23.40[9]	3.00[6]	1:9.01[5]	20	H
5.	Quinalphos 20 AF	20	16.90[3]	1.33[2]	1:16.53[1]	6	B
6.	Quinalphos 20 AF	25	12.05[1]	0.66[1]	1:15.75[3]	5	A
7.	Carbosulfan 25 EC	15	23.04[3]	4.33[7]	1:4.55[9]	24	I
8.	Carbosulfan 25 EC	20	19.93[6]	2.33[5]	1:7.38[7]	18	F
9.	Carbosulfan 25 EC	25	19.28[5]	2.00[4]	1:6.29[8]	17	E

Thus, the highest dose of both formulations of quinalphos proved highly effective in preventing yield loss in groundnut pod. The result further indicated the highest avoidable loss in the dry fodder yield of groundnut in control (52.16%) which was followed by carbosulfan 25 EC, quinalphos 25 EC and carbosulfan 20 AF all @ 15 ml per kg seeds, wherees, the lowest yield loss was recorded in the treatment of quinalphos 20 AF @ 20 ml per kg seeds and it was closely followed by quinalphos 25 EC @ 25 ml loss in groundnut crop have been reported between 50 and 100 per cent from Gujarat, Rajasthan and Punjab (Shah *et al.*, 1975, Yadava *et al.*, 1977 and Bakhetia, 1982), which explicate the present findings.

Economics of seed treatment

Economics of seed treatment against whitegrub was worked out considering prevailing market price of insecticidal treatment including labour charges and groundnut pod as well as dry fodder yield. The results indicated highest net gain in pod yield (Rs. 11882/ha) as well as dry fodder (Rs. 1157/ha) the treatment of quinalphos 20 AF 25 ml over control followed by quinalphos 25 EC 25 ml (Rs. 11622 for pod and Rs. 1004 per ha for dry fodder). Likewise, the highest total net gain over control was observed in quinalphos 20 AF 25 ml (Rs. 13039/ha) followed by quinalphos 20 EC 25 ml (Rs. 12626) and 20 ml (Rs. 11096/ha) and quinalphos 20 AF 20 ml per kg seeds (Rs. 11050/ha).

The results further indicated maximum net profit in the seed treatment of quinalphos 20 AF 25 ml per kg seeds (Rs. 12261/ha) and it was closely followed by same dose of quinalphos 25 EC (Rs. 11828/ha), quinalphos 20 AF 20 ml (Rs. 11420/ha) and quinalphos 25 EC 20 ml per kg seeds (Rs. 10450/ha). The net profit was obviously minimum in the seed treatment of carbosulfan 25 EC 15 ml dose (Rs. 2948.9/ ha). The highest net incrimental cost benefit ratio (NICBR) was observed in the seed treatment of quinalphos 20 AF 20 ml per kg

seeds (1:16.53) and it was closely followed by quinalphos 25 EC 20 ml (1:16.17), quinalphos 20 AF 25 ml (1:15.75) and quinlaphos 25 EC 25 ml per kg seeds (1:14.82).

Multiple ranking for overall effectiveness of seed treatments

To judge the best treatment from view point of its efficacy against whitegrub as well as a multiple ranking system was adopted. For this purpose, theree characters viz., cumulative plant mortality, grub population and NICBR were taken in to consideration. The treatment that showed lowest plant mortality was assigned numerical rank 1 (Table-3). The treatment were assigned such ranks in ascending order with increase in plant mortality. The treatments having same value of character were assigned same numerical rank. Similar rank was also assigned for grub population. In case of NICBR, the treatment that gained the highest ratio was assigned rank 1 and remaining treatment were assigned such ranks in descending order of value of NICBR. The ranks obtained by a treatment for all the three characters were added to obtain a total rank. The treatment that gained the least total rank was considered as the best treatment in all aspects and assigned an alphabetic rank 'A'. The remaining treatments were ranked from 'B' onward according to ascending order of their total rank. Thus, quinalphos 20 AF @ 25 ml per kg seeds was adjudged as the best for seed treatment against whitegrub in groundnut and it was followed by the 20 ml dose of the same treatment quinalphos 25 EC @ 25 ml and 20 ml per kg seeds.

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