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Combination Treatments for the Control of Insect Pests, Mite, Virus Vector. Nematodes, Fungal and Viral Diseases of Bhendi, *Abelmoschus esculentus* (L.) Moench.

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ABSTRACT

Among the nine combinations tested in two field experiments during 1975, seed treatment with Agrosan, followed by application of aldicarb granule at 1.0 kg a.i./ha a week after sowing and spraying with endosulfan 0.07 per cent at 30 days after sowing and endosulfan 0.07 per cent + wettable sulphur 0.5 per cent at 50 and 65 days after sowing was effective. The comparative performance of different treatments in the control of pests and diseases as well on the yield is discussed.

INTRODUCTION

Several studies have been made in recent years to control insect pests (David, 1965; Srinivasan *et al.*, 1973; Palaniswamy *et al.*, 1974), nematodes (Sivakumar *et al.*, 1973 a, b), powdery mildew (Lakshmi Ramakrishnan *et al.*, 1975) and yellow vein mosaic (Palaniswamy *et al.*, 1973) affecting bhendi. The results of these investigations brought out several recommendations involving many chemicals and different application schedules which were difficult to adopt together, by the vegetable growers to keep the crop free from pests and diseases. In view of this, field experiments were conducted to evolve a common schedule of treatment for controlling the insect pests, mite, nematodes, virus vector, fungal and viral diseases of bhendi and the results are presented.

MATERIALS AND METHODS

Two field experiments were conducted, the first during January to April and the second during August to November, 1975 in randomized block design with three replications and ten treatments. Except the seeds used for the treatment 'Untreated check', the other seeds were treated with Agrosan G. N. at 2 g/kg of seed. The bhendi variety, *Pusa Sawani* was used in both the experiments. The treatments were 1. Carbofuran 6 per cent a.i on seed + 2 per cent starch as sticker, followed by monocrotophos 0.1 per

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cent and morestan 0.05 per cent spray, 2. Carbofuran 6 per cent on seed + 2 per cent starch as sticker, followed by sevimol 0.1 per cent and morestan 0.5 per cent spray, 3. Carbofuran 6 per cent a.i. on seed + 2 per cent starch as sticker, followed by endosulfan 0.07 per cent and morestan 0.05 per cent, 4. Aldicarb granule 1.0 kg a.i./ha, followed by monocrotophos 0.1 per cent and morestan 0.05 per cent spray, 5. Aldicarb granule 1.0 kg a.i./ha followed by sevimol 0.1 per cent and morestan 0.05 per cent spray, 6. Aldicarb granule 1.0 kg a.i./ha followed by endosulfan 0.07 per cent and morestan 0.05 per cent spray, 7. Disulfoton granule 1.5 kg a.i./ha followed by monocrotophos 0.1 per cent and morestan 0.05 per cent spray, 8. Disulfoton granule 1.5 kg a.i./ha followed by sevimol 0.1 per cent and morestan 0.05 spray, 9. Disulfoton granule 1.5 kg a./ha followed by endosulfan 0.07 per cent and morestan 0.05 per cent spray, and 10. Untreated check. In treatments 1, 2 and 3, monocrotophos, sevimol and endosulfan were applied at 25, 40 and 55 days after sowing and morestan on 40 and 55 days after sowing. In treatments 4 to 8, granules were applied a week after sowing and monocrotophos, sevimol and endosulfan at 35, 50 and 60 days after sowing and morestan at 50 and 65 days after sowing. In the second experiment, morestan was replaced by wettable sulphur 0.5 per cent, as the former had phytotoxic effect on bhendi leaves and fruits.

The population of leafhopper, *Amrasca biguttula biguttula*, aphid, *Aphis gossypii* and mite, *Tetranychus cinnabarinus* was assessed at fortnightly intervals from 15 days after sowing. Ten plants were selected at random in each plot and the pest population was recorded. The total number of nymphs and adult leafhoppers in three leaves per plant representing top, middle and bottom regions were recorded. For assessing the population of aphids and mites, three leaves were selected representing top, middle and bottom regions of the plants, and in each leaf, 3^2 cm area was examined. While sampling, the areas where maximum colonization of aphid/mite existed were selected.

The population of white fly, (*Bemisia tabaci*) vector transmitting yellow vein mosaic virus was assessed in three leaves in each of 10 plants selected at random in each plot. From the tenth day after sowing, the population was recorded at 10 days interval up to 50 days. The yellow vein mosaic incidence was recorded at 30, 45, 60 and 75 days after sowing as percentage of diseased plants with reference to total plants. The powdery mildew infection caused by *Erysiphe cichoracearum* was recorded as percentage.

The fruit borer (*Earias* spp.) infestation was assessed at each harvest and recorded as percentage to the total fruits harvested. The population of *Rotylenchulus reniformis* was assessed in the first experiment from 200 g of composite soil sample, and that of *Helicotylenchus* sp., in the second experiment from 200 g of root

meterial collected from each plot, after the completion of all treatments. The data collected in both the experiments were pooled and analysed statistically.

RESULTS AND DISCUSSION

The results of the first experiment are presented in Table I. There was significant difference in the population

TABLE I Incidence of pests and diseases in different treatments-Experiment I

Treatment	Mean population of pests and incidence of disease								
	Aphid (T. V.)	Leaf-hopper (T. V.)	Mite (T. V.)	White fly (T. V.)	Fruit borer (T. V.)	Nematode (In 200g soil)	Yellow vein mosaic (T. V.)	Yield kg/plot	Additional profit over check Rs/ha
Carbofuran 6% on seed Monocrotophos 0.1% Morestan 0.05%	0.764	0.737	0.743	0.804	18.33	336	1.589	11.78	2763
Carbofuran 6% on seed Sevimol 0.1% Moreston 0.05%	2.872	0.814	1.763	0.810	18.07	848	1.426	8.31	1975
Carbofuran 6% on seed Endosulfan 0.07% Morestan 0.05%	1.572	0.943	1.767	0.799	16.62	110	1.174	9.58	2394
Aldicarb G 1.00 kg a.i./ha Monocrotophos 0.1% Moreston 0.05%	0.714	0.730	0.744	0.725	18.34	342	1.699	12.16	2543
Aldicarb G 1.00 kg a.i./ha Sevimol 0.1% Moretan 0.05%	1.262	0.776	0.714	0.743	17.42	293	0.998	11.64	2913
Aldicarb G 1.00 kg a.i./ha Endosulfan 0.07% Morestan 0.05%	1.072	0.746	0.737	0.753	15.49	193	0.983	13.28	3465
Disulfoton G 1.5 kg a.i./ha Monocrotophos 0.1% Morestan 0.05%	1.076	0.773	0.922	0.825	17.04	528	0.808	9.39	1422
Disulfoton G 1.5 kg a.i./ha Sevimol 0.1% Morestan 0.05%	0.861	0.803	1.128	0.818	16.22	425	1.086	10.55	2305
Disulfoton G. 1.5 kg a.i./ha Endosulfan 0.07% Morestan 0.05%	0.976	0.823	1.728	0.827	18.13	592	1.576	9.81	2002
Untreated check	6.233	0.997	1.081	0.711	20.67	1962	1.146	1.82	—
F Test	**	N. S.	**	**	N. S.	**	**	**	
C.D. (P=0.05)	1.30	—	0.67	0.05	—	515.2	0.32	3.38	

** - Significant at 1% level N. S. - Not significant T. V. - Transformed value

of aphid, mite, white fly vector, nematode and yellow vein mosaic incidence between the treatments. The yield was also significantly influenced by application of insecticides and fungicide. Among the treatments, considering the overall effect on the control of insect pests, mite, nematode and yellow vein mosaic, application of aldicarb granule, followed by endosulfan

TABLE II Incidence of pests and diseases in different treatments - Experiment II

Treatment	Mean population of pests and incidence of disease									
	Aphid (T. V)	Leafhopper (T. V)	Mite (T. V)	White fly (T. V)	Fruit borer (T. V.)	Nematode (In 200g root)	Powdery mildew (T.V)	Yellow vein mosaic (T. V)	Yield kg/plot	Additional profit over check Rs/ha
Carbofuran 6% on seed Monocrotophos 0.1% Wettable sulphur 0.5%	0.84	0.72	0.71	0.73	2.04	277	28.04	0.99	15.53	2771
Carbofuran 6% on seed Sevimol 0.1%; W. sulphur 0.5%	1.84	0.75	1.50	0.75	1.41	377	28.27	0.80	11.91	1670
Carbofuran 6% on seed Endosulfan 0.07%; W. sulphur 0.5%	1.23	0.73	1.09	0.76	1.47	383	14.77	0.79	12.16	1742
Aldicarb G 1.00 kg a.i./ha Monocrotophos 0.1%; W. sulphur 0.5%	0.79	0.73	0.71	0.78	1.58	243	33.47	0.87	15.16	2356
Aldicarb G 1.00 kg a.i./ha Sevimol 0.1%; W. sulphur	0.86	0.73	0.77	0.79	1.63	223	32.99	1.15	13.74	2199
Aldicarb G 1.00 kg a.i./ha Endosulfan 0.07%; W. sulphur 0.5%	0.75	0.72	0.73	0.77	1.59	300	23.03	0.89	14.08	2309
Disulfoton G 1.5 kg a.i./ha Monocrotophos 0.1%; W. sulphur 0.5%	0.83	0.76	0.75	0.80	1.73	403	25.21	1.38	11.62	613
Disulfoton G 1.5 kg a.i./ha Sevimol 0.1%; W. sulphur 0.5 %	1.00	0.75	0.74	0.81	2.45	330	28.89	1.29	11.54	1038
Disulfoton G 1.5 kg a.i./ha Endosulfan 0.07; W. sulphur 0.5%	0.90	0.76	0.79	0.78	2.22	353	23.82	1.03	12.35	1350
Untreated check	3.53	1.09	1.44	0.76	1.94	70	44.23	0.86	7.60	—
F test	**	**	N.S.	N.S.	N.S.	N.S.	*	**	**	
C. D. (P = 0.05)	1.05	0.17	—	—	—	—	9.37	0.24	0.95	

** - Significant at 1% level * - Significant at 5% level N.S. - Not significant
T. V. - Transformed Value

and morestan spray (T_6) was found to be very effective. The additional profit accrued by adoption of different treatments also revealed that T_6 was the most profitable to adopt. In this experiment, the differences between treatments in the population of leafhopper and infestation by fruit borer are, however, not significant. Further, the crop was not infected by powdery mildew or any of the other fungal diseases, and the nematode species in the soil was predominantly, *Rotylenchulus reniformis*.

The observations recorded in the second experiment conducted during August-November are presented in Table II. Significant differences existed in the population of aphid, leafhoppers, yellow vein mosaic, powdery mildew and yield between treatments, while no significant variations could be observed in the population of mite, white fly vector, nematode and infestation by fruit borer. A critical analysis of the efficiency of different treatments in keeping the pests and diseases under check, revealed that aldicarb, thiodan, wettable sulphur (T_6) combination was superior, although, in this experiment, maximum additional profit was obtained in T_1, followed by T_4 and T_6. However, an overall scrutiny on the relative merits of different combination treatments in both the experiments would reveal, that aldicarb, thiodan and wettable sulphur (T_6) combination was the best in keeping under effective check of insect pests, mite, nematodes, fungal and viral diseases ravaging bhendi crop and in increasing the fruit yield significantly.

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