The loss in dry matter production ranged from 3.6 to 62.5% in big size, 10.2 to 62.3% in medium size and 11.3 to 77.7% in respect of small bulbs at the end of 8 months of storage period. The vigour index value showed a significant loss for size grades of bulbs in storage Intially, the VI value was found to be 261, 254 and 250 in big, medium and small bulbs respectively which at the end of 8th month of storage gave a VI value of 8.13, 4.27 and 1.23 respectively (Table 5).

The study revelaed that for long term storage, the big size bulbs of CV CO 4 aggregatum onion have to be stored in a dry condition.

REFERENCES

Achar, H. P., Patil, V. S. Reddy, M.R. and Ansari M. R., 1984. Effect of moisture regime and fertilizer levels on yield of onion. *Curr. Res.* 13 (4-6) : 29-30.

Deshmukh, V., Patil, M. M. and Wagre, P. K. 1984. Field study on response of onion to phosphorus, pottassium and iron in vertisol. Punjabrao Krishi Vidyapeeth Research Journel 8. *Hort. Abst. 1* : 312.

Khurana, S. C. and Singh C. B. 1984. A note on loss in weight during storage of onion bulbs *Haryana J. Hort. Science, 13* : 186-188.

https://doi.org/10.29321/MAJ.10.A02042

Madras Agric. J. 76 [3] : 155—162 March, 1989

EVALUATION OF EXPERIMENTAL DESIGNS TO TACKLE INTERPLOT DISPERSAL OF INSECTS

P. R. RAMACHANDER K. SRINIVASAN G. S. P. RAO and P. N. KRISHNAMOORTHY
Indian Institute of Agricultural Research, Banglore-560 089

ABSTRACT

Efficacy of 0.01% fenvalerate, 0.07% endosulfan and 0.1% dichlorvos for the control of *Plutella xylostella* on cabbage was evaluated using three experimental designs *viz.*, randomized block, serial block and exploded block design. The results indicate probability of incorrect inferences that could be drawn for efficacy reports when randomized block design and serial block design are followed due to interplot movement of insects. Based on the results obtained, suitability of adopting modified exploded block design which has limited interplot movement has also been indicated for testing insecticides with varying efficacy.

Keywords : Experimental designs, Dispersal of insects, Insecticides

Entomologists are often confronted with problems relating to change in dispersal of insect pests in an experimental field (Taylor, 1987). These are usually triggered by an insecticidal application. Sometimes, unsprayed control plots may provide a source of infestation, which can affect population in the neighbouring plots. The effect of infestation from the untreated control plot to adjacent plots will vary according to effectiveness of chemical used in the neighbouring plots. Conventional design like randomized blocks in which plots are close together are thought to be unsatisfactory to check this dispersal problem (Dyke and Shelley, 1976). In several instances, exploded designs in which the plots are separated by large areas of barrier crops have been used to overcome this problem (Rothamsted, 1974). Dyke and Shelley (1976) suggested serial block design with balanced set of neighbours to minimise errors in interpretation caused due to dispersal of insects in insectide test trials.

The diamondback moth, *Plutella xylostella* (Linnaeus) is the major pest of cabbage in india. Evidence has been presented regarding dispersal of *P. xylostella* over long distances (List, 1937; Harcourt, 1957; shaw, 1962; French, 1965). The objective of this study was to determine the relative effectiveness of three experimental designs to adjust for the possible dispersal from plot to plot.

MATERIALS AND METHODS

Three experimental designs *viz.*, randomized block, serial block and exploded block were evaluated simultaneously during early winter (September to November) with cabbage cv. Pride of India. The following insecticides *viz.*, (i) fenvalerate (Sumicidin 20 EC) 0.01% (ii) endosulfan (Thiodan 35 EC) 0.07% and (iii) dichlorvos (Nuvan 100) 0.1% along with control (untreated check) were evaluated in all the designs.

Three sprays of chemicals were applied at 15, 30 and 45 days after planting. Counts of diamondback moth larvae were taken on 7th and 14th day after each spray from ten randomly selected plants. Counts of insects taken on 7th and 14th day after third spray were not included for analysis since 50% of the cabbage heads were harvested around 50 days after planting. The details of method followed under each design are as follows.

← 5m →

3m

A	C	A
B	B	C
A	C	A
C	A	B
D	D	D
A	A	B
B	D	A
C	B	D
D	C	C
B	B	D
D	D	C
A	C	B
C	A	A
B	C	B

A = Fenvalerate C = Dichlorvos
B = Endosulfan D = Control

Randomized block design (RBD) : It had six replications. Individual plot size was 15 m². Five ridges and furrows were made in each plot with a spacing of 50 cm between ridges and 30 day old cabbage seedlings were planted 50 cm apart along the sides of ridges. Fortyfive plants were maintained per plot. Data were analysed using method suggested by Cochran and Cox (1950).

Serial block design (SED) : The original design suggested by Dyke and Shelley (1976) consisted of 38 plots arranged in a serial order. This design has limitations in laying out because serial arrangement of plots would result in unusual lengthy strip leaving vacant space in the field. Furthermore, coefficient of variation of such an arrangement would be disproportionately large. Hence the design was split into three columns of 14 plots as shown in Fig. 2. Individual plot size and planting pattern were similar to that described under RBD. Analysis of data was done as per method given by Dyke and Shelley (1976).

Exploded block design (EBD) : The original concept of this design envisaged different blocks for each treatment which are separated by large distances. This design had inherent managemet problems. The design was modified in such a way that each block was separated by a cultivated barrier consisting of okra which is a non-host for cabbage caterpillars. Individual block measured 30 m². Ten ridges and furrows were made in each block and 90 plants were maintained. Each block was separated by 15 m² area under okra. Observations were recorded on

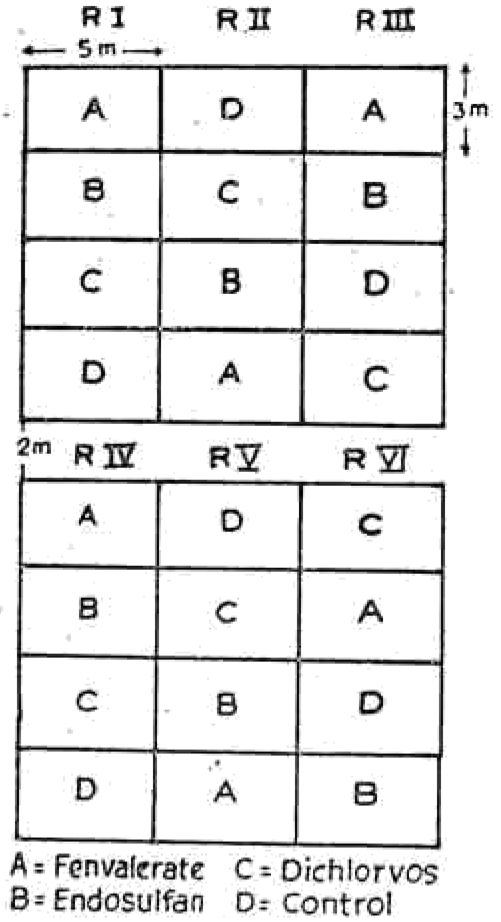


Table 1. Efficacy of insecticides for the control of *P. xylostella* in different treatments under RBD

Treatments	Population of *P. xylostella* on different days after			
	I spray		II spray	
	7	14	7	14
Fenvalerate	0	0.53a	0.20a	0.07a
Endosulfan	0	0.43a	0.13a	0.10a
Dichlorvos	0	0.50a	0.30a	0.53a
Control	0	1.67b	1.20b	1.63b
CD 5	NS	0.52	0.40	0.47

NS = Non Significant

Means in the same column with letters in common are not significantly different

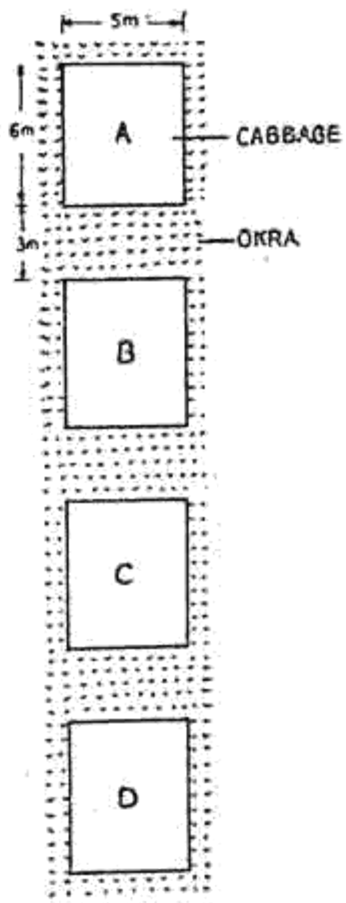
Table 3. Efficacy of insecticides for the control of *P. xylostella* in different treatments under EBD

Treatments	Population of *P. xylostella* on different days after			
	I spray		II spray	
	7	14	7	14
Fenvalerate	0.30	0.26	1.13	0.74
Endosulfan	0.52	0.78	0.82	1.52
Dichlorvos	0.43	0.69	0.52	1.52
Control	1.04	1.65	1.65	8.13
1 Vs 2	0.81 NS	1.57 NS	0.77 NS	1.53
1 Vs 3	0.49 NS	1.36 NS	1.69 NS	1.69
1 Vs 4	2.38 @	3.20 @	2.97 @	5.80 @
2 Vs 3	0.27 NS	1.01 NS	1.02 NS	0.82 NS
2 Vs 4	1.40 NS	1.55 NS	1.64 NS	4.38 @
3 Vs 4	1.69 NS	1.75 NS	1.46 NS	4.40 @

@ Significant at 5 level
NS = Non Significant

and second sprays compared to rest of the treatments. Significant reduction of larval population was also observed in endosulfan and dichlorvos treated plots only on 14 days after second spray as compared to control.

These results demonstrated that efficacy of insecticides in reducing population levels of *P. xylostella* varied to a great extent depending upon the designs that were used. It was also construed that efficacy of treatments might have varied depending upon the dispersal that each design allowed from plot to plot. Fenvalerate was the only chemical to provide consistent reduction of larval population on different days after each spray in EBD while in other designs, all the chemicals tested were at par.



A: Fenvalerate
B: Endosulfan
C: Dichlorvos
D: Control

Fenvalerate has been reported to be an effective insecticide with long residual toxicity widely used for the control of this pest (Srinivasan and Krishnakumar, 1985). Under the assumption of limited dispersal of insects in EBD plots, an effective chemical like fenvalerate provided consistent reduction on all days with limited interference due to movement from other plots. On the other hand, there is a possibility of interplot movement of pests in both RBD and SBD designs. The interplot movement could take place either from control plots or from plots which are sprayed with less effective insecticides after a gap of few days. These factors might have masked the real efficacy of fenvalerate in reducing the larval population. This might have led to non-significant differences in the population levels in all the treated plots as compared to control in both RBD and SBD that were tested.

The percentage increase or decrease in the population level of *P. xylostella* on 14 days as compared to 7 days after each spray for different insecticides tested under various designs are given in Table 4. Observations made on 14 days after first spray with fenvalerate registered 53 and 42% increase in RBD and SBD, respectively. Thereafter on 14 days after second spray, there was marginal decrease of larval population to the tune of -13 and -2% in RBD and SBD, respectively. There was steady decline of -4 and -39% on 14 days after first and second spray in the RBD plots. The fact that steady decline in the population level recorded in fenvalerate treated EBD plot strengthended our belief that there would not have been any interference like dispersal from neighbouring plots. An initial buildup on 14 days after first spray in the RBD and SBD suggested that dispersal might have taken place from neighbouring plots affecting the accuracy of treatment effect.

Endosulfan has been reported to have moderate toxicity against *P. xylostella* (Srinivasan and Krishnakumar 1985). The population build up 14 days after each spray in RBD and SBD plots was erratic. However EBD plot registered steady increase in the population level (26 and 70%) on the 14th day after first and second spray. This once again is in conformity with the belief that under limited dispersal condition between plots in in EBD, there should be moderate increase of the pest using a less effective chemical like endosulfan on the 14th day after each spray.

In the dichlorvos treated plots, where the insecticide has low residual toxicity, there was sudden build up of the pest in EBD plot on both 14 days after first and second sprays. Such type of phenomenon was not observed in RBD and SBD designs (Table 4).

Dispersal could take place either between plots in an experimental field or immigration from surrounding areas or emigration from treated areas to sourrounding areas. The results obtained in this study gave an indication about possible dispersal that could take place between plots in designs like RBD and SBD affecting the precision of observation. However, accurate meth-

Table 4. Percentage increase/decrease of *P. xylostella* population on 14 days as compared to 7 days after each spray

Treatments and observation day	Percentage increase or dosages decrease in different RBD	SBD	EBD
Fenvalerate			
14 DAIS	53	42	—4
14 DAIIS	—13	—2	—39
Endosulfan			
14 DAIS	43	128	26
14 DAIIS	—3	0	70
Dichlorvos			
14 DAIS	50	45	86
14 DAIIS	23	58	100

DAIS = Days After First Spray
DAIIS = Days After Second Spray

ods have to be devised to estimate this dispersal between plots. The data obtained from this experiment also indicated suitability of adopting EBD for evaluting insecticides under limited dispersal conditions. The accuracy of this design could be further increased by replicating the blocks and taking observations from larger samples in each block. EBD has several limitations if it is to be adopted by reserach workers e. g., large area under one treatment, growing of non-host plants between blocks etc. Hence more work on this aspect has to be done before conclusions and recommendatious about the suitability of this design is suggested for evaluation of insecticides with varying efficacy.

ACKNOWLEDGEMENT

The authors wish to express their sincere thanks to Director, Indian institute of Horticultural Research for facilities. Thanks are also due to Mr. B. Munirathnaiah, and Mr. S. Venkateshaiah for their technical assistance.

REFERENCES

Cochran, W. G. and Cox G. M. 1950. *Experimental Desion*, John Wiley and Sons Inc., New York, 450 pp.

Dyke, G. V. and Shelley C. F. 1976 Serial designs balanced for effects of neighbours on both sides. *J. agric. Sci.* Camb., *87* : 303-305.

French, R. A. 1966. Long distance movement of two migrant leg pidoptera in relation to synoptic weather conditions. *Biometeorology, II, Proc. Third Int. Biomet. Congr.* 1963, pp. 565-569.

Hatcourt, D. G. 1957. Biology of the diamondback moth. *Plutella maculipennis* (Curt.) (Lepidoptera : Plutellidae) in Eastern Ontario. II. Life history, behaviour and host relationships. *Can. Ent. 89* : 554-564.

Krishnaiah, K. and Jagan Mohan, N. 1977. Control of cabbage pests by new insecticides. pp. 88-89. In paper presented at the Second Oriental Entomology Symposium, Loyola-College, Madras, India (Abstracts).

List, G. M.1937. Possible migration of diamondback moth. *J. Econ. Entomol. 30* : 676.

Panse, V. G. and Sukhatme, P. V. 1978. *Statistical Methods for Agricultural Workers,* Indian Council of Agricultural Research, New Delhi, pp. 53-58.

Rothamsted, 1974. Rothamsted Experiment Station Report for 1973, part 1, pp. 127-128.

Shaw, M. W. 1962. The diamondback moth migration, 1951. *Weather 17* : 221-234.

Shah, A. H., Patel, C. B. and Patel M. B. 1984. Field evaluation of some new insecticides for the control diamondback moth, *Plutella xylostella* L. *Pestology 8* : 20-22.

Srinivasan, K. and Krishna Kumar, N. K. 1985. Evaluation of syntretic pyrethroids and conventional insecticides for the control of diamondback moth and leafwebber in cabbage. *South Indian Hort 33* (2) : 103-107.

Taylor, R. A. J. 1987. On the accuracy of insecticide efficay reports. *Environmental Entomology 16* (1) : 1-8.

RESEARCH NOTES

Madras Agric. J. 76 [3] : 162—165 March, 1989

CONTROL OF RICE WEEVIL *Sitophilus oryzae* L. ON RESISTANT AND SUSCEPTIBLE SORGHUM ACCESSIONS

The combination of resistant varieties and reduced dosage of chemicals in the control of pests is important in integrated pest management. A number of cases were documented where the host effects the case of controls with chemicals (Potter and Gilham, 1957; Painter, 1960). Hence, present study was undertaken with resistant varieties and reduced concentration of insecticides with management of rice weevil, *Sitophilus oryzae* L. and the results are presented.

The test accessions IS 7173 (R_1), IS 3443 (R_2), IS 3606 (MR_1), IS 3569 (MR_2), IS 8789 (S) and PJ, 32K (HS) were mixed with dichlorvos (Nuvan 100 EC), phoxim (Valexon 50 EC), malathion (Malathion 50 EC) and fenitrothion (Sumithion 50 EC) @ 1 : 200 w/w. The materials were shade dried over night. Three replications each of 100 g were taken and kept in the sample gunny bags. Fifty pairs of *S.oryzae* L. were introduced in each of the gunny bags and left for a period of 9 months. Observations were carried out at trimonthly intervals. The percentage loss in each variety was assessed as per the method suggested by Krishnamurthy (1974).

The results of the studies revealed that the resistant accessions IS7173 and IS 3443 had 8.34 and 8.45 percent losses only compared to 19.08 in highly susceptible (HS) PJ 32 K. Moderately Resistant (MR) accessions IS 3606 and IS 3569 and susceptible (S) IS 8789 recorded the average loss of 12.27, 13.01 and 15.75 per cent respectively. The interactions between accessions and chemicals as well as accessions and periods were significant (Table 1). The average loss due to weevil damage was found to increase when the susceptibility of