



Research Article

ASSESSMENT OF QUANTITATIVE LOSSES DUE TO INSECT PESTS OF CABBAGE

JAT G.C., LEKHA RAWAL*, JAT S.K. AND YADAV P.C.

Department of Entomology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, 313001, Rajasthan

*Corresponding Author: Email-lekha.rca@gmail.com

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Abstract- A field experiment was conducted during *Rabi* season of 2012-13 and 2013-14 at Horticulture Farm, RCA, Udaipur, involving the assessment of quantitative losses due to insect pests of cabbage. The cabbage variety Golden Acre was sown in 26 plots with each plot measuring 3.6 x 3.6 m². One set of plots was kept protected from insect infestation by regular application of recommended pesticides and the other set was exposed to natural infestation throughout the crop growth. The insect-pests infestation caused 21.76 and 20.15 per cent reduction in plant height of cabbage during *rabi* 2012-13 and 2013-14, respectively. The insect-pests infestation also affected the weight of cabbage head per plant with a mean loss of 25.17 and 23.73 per cent during *rabi* 2012-13 and 2013-14, respectively. On the basis of difference obtained in net yield between protected and unprotected plots, the avoidable quantitative loss was estimated as 32.67 per cent during 2012 and 29.33 per cent during 2013.

Keywords- Insect pests, losses, *Rabi*, infestation, Cabbage.

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Introduction

Cruciferous vegetables have an important place among *rabi* crops grown in India. Cabbage, *Brassica oleracea* var. *capitata* (Linn.), is a popular vegetable that is grown in all the states of India and has appreciable nutritional and economic value. Among cole crops it is most widely cultivated in cold climate; it is known for its "head" and consumed as both raw and cooked form. Cabbage, the leafy vegetable is a rich source of vitamins and minerals. Dieticians regarded as a wholesome tonic for maintaining optimum health. It is good source of the Vitamin C and also rich in glutamine content, with anti-inflammatory properties. Insect pests are a serious menace in the profitable cultivation of cabbage. The important insect pests that infest cabbage crop are the tobacco caterpillar (*Spodoptera litura* Fab.), diamond back moth (*Plutella xylostella* L.), cabbage semilooper (*Trichoplusia* Hubner), painted bug (*Bagrada hilaris* Burmeister and *Bagrada cruciferarum* Kirk.), cabbage butterfly (*Pieris brassicae* L.), flea beetle (*Phyllotreta cruciferae* Goeze), aphids (*Lipaphis erysimi* Kalt. and *Brevicoryne brassicae* L.), Cabbage leaf webber (*Crociodolomia bionotalis* Zell) and the mustard saw fly (*Athalia lugensproxima* Klug.) [1].

Among these, *Spodoptera litura* (Fab.) (Lepidoptera: Noctuidae), is a major pest of cabbage. The caterpillars voraciously feed on the leaves and in nurseries entire seedbeds get defoliated within a week. The pest causes damage to an extent of 80-100 per cent in the nurseries under favourable conditions [2] and 10-25 per cent to the field crop [3]. Choudhary *et al.* (2001) [4] observed that damage incurred by adult *P. cruciferae* was significantly high (71.40%) in the seedling of cabbage. Singh (2002) [5] recorded that the losses caused by the *P. xylostella* ranged from 20.00 to 52.00 per cent. In the present investigation the effect of insect pests on yield and various yield attributing characters viz., plant height, weight of head per plant and mean head damage were analyzed.

Materials and Methods

The field trial was carried out at Horticulture Farm of Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur during *rabi* 2012-13 and 2013-14. The trial was laid out in randomized block design with three replications. Cabbage variety Golden acre was sown at 45 cm spacing (row to row) having plot size of 3.6mx3.6m. The estimation of losses due to insect pests of cabbage was worked out using paired plot design. One set of plots was kept protected from insect infestation by regular application of recommended pesticides and the other set was exposed to natural infestation throughout the crop growth. Ten plants were selected randomly from each plot both in the protected and unprotected sets and various yields attributing characters viz., plant height, weight of head per plant and mean head damage were recorded separately.

The losses consequent to infestation by insect pests were calculated by the formula given by Le Clerg (1971) [6].

$$\text{Mean loss in yield} = \frac{X_1 - X_2}{X_1} \times 100$$

Where,

X_1 = Yield in treated (protected) plot

X_2 = Yield in untreated (unprotected) plot

The yield data and yield attributing characters of plant were also subjected to statistical analysis and significance was tested using the "t-test" as under:

$$\text{Standard deviation (sd)} = \sqrt{\frac{\text{Sum of squares of the deviation from the mean difference}}{\text{Number of paired plots} - 1}}$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \sim t_{n_1 + n_2 - 2} \text{ d.f.}$$

$$S^2 = \frac{1}{n_1 + n_2 - 2} \left\{ \left[\sum X_1^2 - \frac{(\sum X_1)^2}{n_1} \right] + \left[\sum X_2^2 - \frac{(\sum X_2)^2}{n_2} \right] \right\}$$

Where,

$\bar{X}_1$ = Average yield in treated plot (Protected)

$\bar{X}_2$ = Average yield in untreated plot (Unprotected)

Sd = Standard deviation

S^2 = Pooled variance

n_1 = Sample size for Protected

n_2 = Sample size for Unprotected

't' = Calculated value

Results and Discussion

The losses due to insect pests in "Golden Acre" variety of cabbage were worked

out by paired plot technique. Actual amount of quantitative loss inflicted by the insect pests together with their effects on yield attributing characters viz., plant height, weight of head per plant and mean head damage were recorded separately and have been presented in [Tables-1-4].

Effects on plant height, weight of cabbage head

The insect pest infestation adversely affected the height of plants and weight of head. The mean height of plant was 29.26 and 29.73 cm in uninfested (protected) plots in comparison to 22.93 and 23.74 cm in infested (unprotected) plots during *rabi* 2012-13 and 2013-14, respectively causing 21.76 and 20.15 per cent reduction in height. Similarly, the mean weight of head per plant in protected and unprotected plots was 517.23 and 384.00g during *rabi* 2012-13 and 535.38 and 404.15g during *rabi* 2013-14, respectively. The per cent reduction in weight of head was 25.17 and 23.73 in the 2012-13 and 2013-14, respectively.

Table-1 Comparative losses due to major insect pests on the basis of mean height of cabbage (cm) in protected and unprotected plots of cabbage during 2012-13 and 2013-14.

Paired plot No	2012-13				2013-14			
	Mean height of cabbage (cm)				Mean height of cabbage (cm)			
	Protected plots (x_1)	Unprotected plots (x_2)	Difference	Mean reduction (%)	Protected plots (x_1)	Unprotected plots (x_2)	Difference	Mean reduction (%)
1.	27.30	22.10	5.20	19.05	27.50	22.80	4.70	17.09
2.	29.00	22.70	6.30	21.72	29.80	23.80	6.00	20.13
3.	27.90	22.20	5.70	21.72	28.20	22.90	5.30	18.79
4.	29.80	23.10	6.70	20.43	30.50	24.0	6.50	21.31
5.	31.80	24.40	7.40	22.48	32.20	25.0	7.20	22.36
6.	27.10	21.90	5.20	23.27	27.50	22.70	4.80	17.45
7.	28.80	22.60	6.20	21.53	29.40	23.60	5.80	19.73
8.	30.20	23.30	6.90	22.85	30.80	24.10	6.70	21.75
9.	28.20	22.40	5.80	20.57	28.50	23.10	5.40	18.95
10.	29.40	22.90	6.50	22.11	30.20	23.90	6.30	20.86
11.	30.80	23.70	7.10	23.05	31.50	24.60	6.90	21.90
12.	31.60	24.30	7.30	23.10	32.00	24.90	7.10	22.19
13.	28.50	22.50	6.00	21.05	28.80	23.20	5.60	19.44
TOTAL	380.40	298.10	82.20	282.93	386.50	308.60	78.20	261.95
MEAN	29.26	22.93	6.32	21.76	29.73	23.74	6.02	20.15
't' Tabulated at 5%				2.16				
't' Calculated at 5%				25.54*				

*The t-value significant at P = 0.05

Table-2 Comparative losses due to major insect pests on the basis of head damage in protected and unprotected plots of cabbage during 2012-13 and 2013-14.

Paired plot No	2012-13				2013-14			
	Mean per cent head damage				Mean per cent head damage			
	Unprotected plots (x_1)	Protected plots (x_2)	Difference	Mean head damage (%)	Unprotected plots (x_1)	Protected plots (x_2)	Difference	Mean head damage (%)
1.	38.10	8.84	29.26	76.80	38.65	10.12	28.53	73.82
2.	32.66	7.95	24.71	75.66	32.97	8.85	24.12	73.16
3.	35.99	8.76	27.23	75.66	36.32	9.95	26.37	72.60
4.	31.92	7.28	24.64	77.19	32.13	7.97	24.16	75.19
5.	27.67	5.67	22.00	79.51	28.12	6.15	21.97	78.13
6.	38.73	9.12	29.61	76.45	38.98	10.34	28.64	73.47
7.	33.10	8.24	24.86	75.11	33.58	9.44	24.14	71.89
8.	30.81	7.12	23.69	76.89	31.10	7.78	23.32	74.98
9.	34.50	8.67	25.83	74.87	35.11	9.88	25.23	71.86
10.	32.43	7.56	24.87	76.69	32.74	8.32	24.42	74.59
11.	30.60	6.83	23.77	77.68	30.87	7.45	23.42	75.87
12.	29.32	6.18	23.14	78.92	29.96	6.87	23.09	77.07
13.	33.67	8.34	25.33	75.23	34.15	9.78	24.37	71.36
TOTAL	429.50	100.56	328.94	996.66	434.68	112.90	321.78	963.99
MEAN	33.04	7.74	25.30	76.67	33.44	8.68	24.75	74.15
't' Tabulated at 5%				2.16				
't' Calculated at 5%				58.64*				

*The t-value significant at P = 0.05

Table-3 Comparative losses due to major insect pests on the basis of head yield per plant in protected and unprotected plots of cabbage during 2012-13 and 2013-14.

Paired plot No	2012-13				2013-14			
	Mean weight of head (gm)				Mean weight of head (gm)			
	Protected plots (x ₁)	Unprotected plots (x ₂)	Difference	Mean weight loss (%)	Protected plots (x ₁)	Unprotected plots (x ₂)	Difference	Mean weight loss (%)
1.	384	307	77	20.53	400	328	72	18.00
2.	515	392	123	23.88	540	418	122	22.59
3.	400	317	83	20.75	425	338	87	20.47
4.	580	427	153	26.38	590	443	147	24.91
5.	700	477	223	31.86	720	498	222	30.83
6.	350	282	68	19.43	375	313	62	16.53
7.	480	367	113	23.54	500	388	112	22.40
8.	610	437	173	28.36	600	428	172	28.67
9.	425	327	98	23.06	450	358	92	20.44
10.	550	407	143	26.00	560	423	137	24.46
11.	625	440	185	29.60	645	463	182	28.22
12.	650	447	203	31.23	680	483	197	28.97
13.	455	352	103	22.64	475	373	102	21.47
TOTAL	6724.00	4979.00	1667.90	327.26	6960.00	5254.00	1706.00	308.46
MEAN	517.23	383.00	128.30	25.17	535.38	404.15	131.23	23.73
‘t’ Tabulated at 5%				2.16				
‘t’ Calculated at 5%				98.49*				

*The t-value significant at P = 0.05

Table-4 Comparative losses due to major insect pests on the basis of yield per plot in protected and unprotected plots of cabbage during 2012-13 and 2013-14.

Paired plot No	2012-13				2013-14			
	Yield (kg/plot)				Yield (kg/plot)			
	Protected plots (x ₁)	Unprotected plots (x ₂)	Difference	Yield loss (%)	Protected plots (x ₁)	Unprotected plots (x ₂)	Difference	Yield loss (%)
1.	30.37	18.63	11.74	38.67	32.40	20.25	12.15	37.50
2.	41.71	26.32	15.39	36.90	43.74	32.54	11.20	25.60
3.	32.40	20.25	12.15	30.10	34.42	22.06	12.36	35.92
4.	46.98	32.16	14.82	31.54	47.79	37.56	10.22	21.39
5.	56.70	38.21	18.49	32.61	58.32	40.02	16.30	27.95
6.	28.35	17.41	10.93	38.59	30.37	19.03	11.34	37.33
7.	38.88	27.30	11.58	37.50	40.50	27.11	13.39	33.06
8.	49.41	35.97	13.44	27.20	48.60	35.35	13.25	27.26
9.	34.42	21.06	13.36	38.82	36.45	25.68	10.77	29.55
10.	44.55	34.54	10.01	22.47	45.36	32.94	12.42	27.38
11.	50.62	35.21	15.41	30.44	52.24	39.18	13.06	25.00
12.	52.65	40.78	11.87	22.54	55.08	40.80	14.27	25.87
13.	36.85	23.08	13.77	37.36	38.47	27.89	10.58	27.50
TOTAL	543.92	370.94	172.97	424.74	563.76	400.44	163.32	381.31
MEAN	41.84	28.53	13.30	32.67	43.37	30.80	12.56	29.33
‘t’ Tabulated at 5%				2.16				
‘t’ Calculated at 5%				28.03*				

*The t-value significant at P = 0.05

Head damage (%)

The mean damage to cabbage heads was 33.04 per cent in unprotected plots, while it was 7.74 per cent when protected during 2012-13. Similarly, the corresponding figures during 2013-14 were 33.44 and 8.68 per cent. Earlier, Agarwal and Dadheech (1990) [7] revealed that yield of cauliflower in protected plots varied from 22.50 to 25.80 kg/plots (plot size was 4 m x 2.5 m) and in unprotected plots it varied from 16.10 to 20.00 kg/plot. The per cent loss in yield ranged from 19.24 to 30.30 per cent with an average of 25.80 per cent. Choudhari *et al.* (2001) [4] observed that damage incurred by adult *P. cruciferae* was significantly high (71.40%) in the seedling of cabbage. Singh (2002) [5] recorded that the losses caused by the *P. xylostella* ranged from 20.00 to 52.00 per cent.

Effect on head damage (%)

The yield data recorded from protected and unprotected plots of cabbage indicated that insect pests caused 32.67 and 29.33 per cent loss in head yield equivalent to a loss of 102.67 and 102.00 q ha⁻¹, during 2012-13 and 2013-14, respectively. Earlier, Ramana *et al.* (1988) [8] reported 13.20 to 22.60 per cent avoidable loss in yield of cabbage infested by *S. litura*. Krishnamoorthy (2004) [9] reported 52.00 per cent yield loss in cabbage due to diamond back moth. Ahmed *et al.* (2009) [10] reported the infestation of *P. xylostella* on cabbage increased gradually from first fortnight of August and led to 100.00 per cent yield losses.

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Abbreviations:

m = meter, cm = centi-meter, *et al.* = and others, d.f = degree of freedom, q = quintal, ha = hectare, kg = kilogram, % = per cent

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest: None declared**References**

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