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Assessment of Quantitative Yield Losses Due to Chemical Intervention in Cabbage (*Brassica oleracea var. capitata*) Under Poly House Conditions

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A B S T R A C T

A field experiment was conducted in polyhouse with two treatments *viz*., protected and unprotected plots with plot size of 100 m^2 each and further each treatment was divided into 13 quadrates with 1.5 X 0.5 m spacing. Protected treatment was kept protected from insect infestation by regular application of recommended pesticides and unprotected treatment was exposed to natural infestation throughout the crop growth. The mean reduction in plant height, weight of cabbage heads and head damage loss caused by insect pest infestation was 24.08 cm and 20.30 cm, 1.36 kg and 0.49 kg and 9.15 per cent and 76.15 per cent in protected and unprotected plots respectively. On the basis of significant mean difference observed in plant height, weight of cabbage heads and head damage lossbetween protected and unprotected plots, the quantitative losses estimated as15.73 per cent, 64.36 per cent, 87.74 per cent, respectively.

Introduction

Cabbage originated in the Mediterranean region and was brought to India during the Mughal era (Gupta, *et al.*, 2016). It is one of the most significant and popular winter vegetable crops farmed in all of India and now grown year-round due to its high commercial value. India produced 9.60 million tonnes of cabbage in 2020-21 from 4.12 lakh ha of land, at an average of 23.27 MT per ha. (Indiastat.com, 2020-21). One of the major issues with the profitable growing of cabbage is insect pest infestations. According to Abhijith *et al.*, (2019) reported that the main pest is the diamond back moth *Plutella xylostella* (Linnaeus), which has a destructive potential ranging between 14 and 84 percent. Although other lepidopteran pests like the cabbage butterfly, *Pieris brassicae* (Linnaeus), the cabbage semilooper, *Trichoplusia ni* (Hubner), the tobacco caterpillar, *Spodoptera litura* (Fabricius),

the cabbage head borer, *Hellula undalis* (Fabricius) and the cabbage leaf webber, *Crocidolomia binotalis* (Zeller) cause extensive damage andsome sucking pests like the cabbage aphid, *Brevicornye brassicae* (Linnaeus), green pea chaphid, *Myzus persicae* (Green) and painted bug, *Bagrada cruciferum* (Burmeister) have also been recorded to cause significant harm.

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 (Chari *et al*., 1994)

Polyhouse horticulture is quickly gaining relevance for its sustainability and higher returns per unit space. As a result, every year more space is added for protected farming. Protected agriculture can be a useful supplement and alternative to the traditional open field production technique in order to boost productivity, quality and output (Kumar and Kumar, 2020).

In the present investigation the effect of insect pests on yield and various yield attributing characters viz., plant height, weight of cabbage head and head damage loss were analyzed.

Materials and Methods

A field experiment was carried out on Assessment of Quantitative Yield Losses Due to Chemical Intervention in Cabbage (*Brassica oleracea var. capitata*) Under Poly house conditions during *rabi*, 2021-22 at Horticultural Polyhouse, College of Agriculture, Rajendranagar.

The experimental site is situated at an altitude of 542.3 m above mean sea level with 17.3850° N latitude and 78.4867°E longitude and it falls under semi-arid tropical climate. Cabbage variety "INDU SEMINIS" was sown at 45X30 cm spacing. Experiment was laid out with two treatments *viz*., unprotected and protected plot with plot size of 100 m^2 each and further each treatment was divided into 13 quadrates with 1.5m X 0.5m spacing. Unprotected plots were kept free from insecticides, whereas, protected plots were kept free from pest damage through application of pesticides at regular intervals throughout the crop growth period Tolfenpyrad 15 EC at 1.5 ml lit^{-1} and Cyantraniliprole 10.26 OD at 0.6 ml lit^{-1} insecticides were sprayed starting from 1st week of transplanting at ten days interval on rotation basis in the protected plots.

Data on plant height, weight of cabbage head and head damage loss from protected plots and unprotected plots were recorded separately at harvest.

The yield from treated and untreated plots was recorded and the avoidable yield losses by timely management of insect pests in cabbage was computed.

The losses consequent to infestation by insect pests was calculated by the formula given by LeClerg (1971).

$$\text{Percent yield loss over control (\%)} = \frac{\text{Yield of protected plot} - \text{Yield of unprotected plot}}{\text{Yield of unprotected plot}} \times 100$$

$$\text{Avoidable yield loss (\%)} = \frac{X1-X2}{X1} \times 100$$

Where X1 = Yield in treated (protected plot)
X2 = Yield in untreated (unprotected plot)

The significant difference between two treatments protected and unprotected plots were worked out by using two sample t-test for each parameter viz., plant height, weight of cabbage heads and head damage loss.

Results and Discussion

Plant height (cm)

Significant difference was observed in plant heights of cabbage between protected and unprotected plants under polyhouse conditions (Table.1). The plant height in protected plots ranged from 22.50 to 25.33 cm with a mean of 24.08 cm as against 19 to 21.45 cm with a mean of 20.30 cm in unprotected plots. The significant difference observed in mean height due to insecticidal intervention was 15.73 per cent (Fig.1).

Weight of cabbage head (kg)

The results presented in the Table.2 showed that there was a significance difference in weight of cabbage head between protected and unprotected plants.

The weight in protected plots ranged from 1.29 to 1.47 kg with a mean of 1.36 kg as against 0.23 to 0.78 kg with a mean of 0.49 kg in unprotected plots. The significant increase in weight of head due to insecticidal intervention was 64.36 percent (Fig.2).

Mean damage of cabbage head (%)

The results presented in the Table.3 illustrated that there was a significance difference in damage of cabbage head between protected and unprotected treatments.

The damage (%) of cabbage head in protected plots ranged from 0.00 to 24 with a mean of 9.15 as against 50.00 to 100 with a mean of 76.15 in unprotected plots. The reduction in mean damage of head due to spraying of insecticides was 87.74 percent (Fig.3).

These findings are in line with those of Krishnamoorthy (2004) reported 52.00 percent yield loss in cabbage due to diamond back moth. The cabbage aphid plays a prominent role in reducing the yield ranging from 50.00 to 80.00 per cent as reported by Khan and Munir (1986). Singh (2002) recorded that the losses caused by the *P.xylostella* ranged from 20.00 to 52.00 percent.

Similarly, Agarwal and Dadheech (1990) reported that the yield of cauliflower in protected plots ranged from 22.50 to 25.80 kg per plot, considering a plot size of 4x2.5 meters.

On the other hand, in unprotected plots, the yield varied from 16.10 to 20.00 kg per plot. The percentage of yield loss ranged from 19.24 to 30.30 per cent, with an average of 25.80 per cent. Chand and Tripathi (2008) reported that *S. litura* caused extensive crop losses in different parts of India.

Ahmed *et al.,* (2018) reported that the infestation of *P.xylostella* on cabbage increased gradually from first fort night of August and led to 100.00 per cent yield losses. Also, Kular and Kumar (2011) reported that mustard aphid and cabbage caterpillar caused a reduction in seed yield that ranged from 6.5 to 26.4 per cent.

The least amount of seed production loss occurred in *E. sativa*, which also had the fewest numbers of cabbage caterpillars (2.4 larvae/plant) and mustard aphids (2.1aphids/plant). Contrarily, *B. carinata* had the highest production loss (26.4%) and was especially sensitive to the cabbage caterpillar (26.2 larvae/plant). Jat *et al.,* (2017) reported insect-pest infestations reduced the height of cabbage plants by 21.76 and 20.15 per cent in the *Rabi* seasons of 2012-13 and 2013-14, respectively.

With a mean loss of 25.17 and 23.73 per cent during *Rabi* 2012-13 and 2013-14, respectively, the insect-pest infestation also had an impact on the weight of cabbage heads per plant.

The unnecessary quantitative loss was assessed at 32.67 per cent in 2012 and 29.33 percent in 2013 based on the difference in net yield between protected and unprotected plots.

Table.1 Difference (%) in protected and unprotected plots of polyhouse with respect to mean weight of cabbage head

No. of quadrates	Mean weight of cabbage head (Kg)			
	Protected plot	Unprotected plot	Difference	Difference (%)
1	1.35	0.61	0.74	**54.81**
2	1.35	0.25	1.10	**81.48**
3	1.25	0.33	0.92	**73.60**
4	1.34	0.60	0.74	**55.22**
5	1.35	0.42	0.93	**68.89**
6	1.29	0.56	0.73	**56.59**
7	1.36	0.50	0.86	**63.24**
8	1.40	0.38	1.02	**72.86**
9	1.35	0.71	0.64	**47.41**
10	1.41	0.51	0.90	**63.83**
11	1.45	0.23	1.22	**84.14**
12	1.33	0.43	0.90	**67.67**
13	1.47	0.78	0.69	**46.94**
Total	**17.70**	**6.31**	**11.39**	**836.67**
Mean	**1.36**	**0.49**	**0.88**	**64.36**
	‘t’Tabulatedat5%			**2.179**
	‘t’Calculatedat5%			**18.65***

Table.2 Difference (%) in protected and unprotected plots of polyhouse with respect to mean weight of cabbage head

No. of quadrates	Mean weight of cabbage head (Kg)			
	Protected plot	Unprotected plot	Difference	Difference (%)
1	1.35	0.61	0.74	**54.81**
2	1.35	0.25	1.10	**81.48**
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Mean	**1.36**	**0.49**	**0.88**	**64.36**
	‘t’Tabulatedat5%			**2.179**
	‘t’Calculatedat5%			**18.65***

Table.3 Difference (%) in protected and unprotected plots of polyhouse with respect to mean damage of cabbage head

No. of quadrates	Mean damage of cabbage head(%)			
	Protected plot	Unprotected plot	Difference	Difference (%)
1	10	70	60	**85.71**
2	0	90	90	**100.00**
3	20	100	80	**80.00**
4	5	66.6	61.6	**92.49**
5	0	80	80	**100.00**
6	16	70	54	**77.14**
7	10	80	70	**87.50**
8	20	50	30	**60.00**
9	0	73.4	73.4	**100.00**
10	4	70	66	**94.29**
11	10	80	70	**87.50**
12	24	100	76	**76.00**
13	0	60	60	**100.00**
Total	**119**	**990**	**871**	**1140.64**
Mean	**9.15**	**76.15**	**67**	**87.74**
	‘t’Tabulatedat5%			**2.179**
	‘t’Calculatedat5%			**16.18***

Fig.1

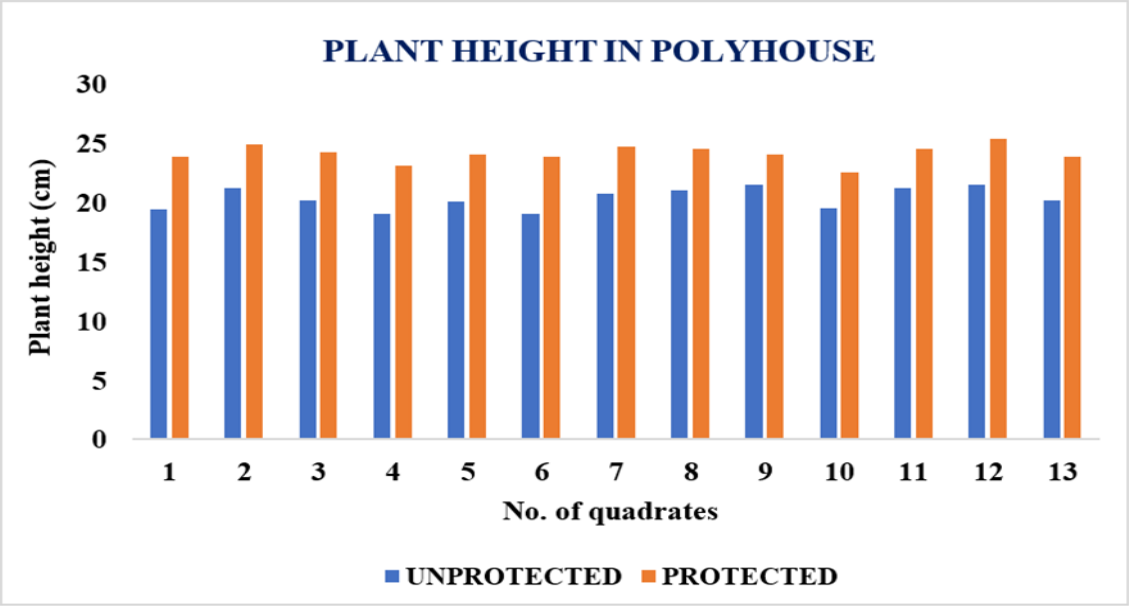

Fig. 1 Plant height in protected and unprotected in Polyhouse *rabi*, 2022-23

Fig.2

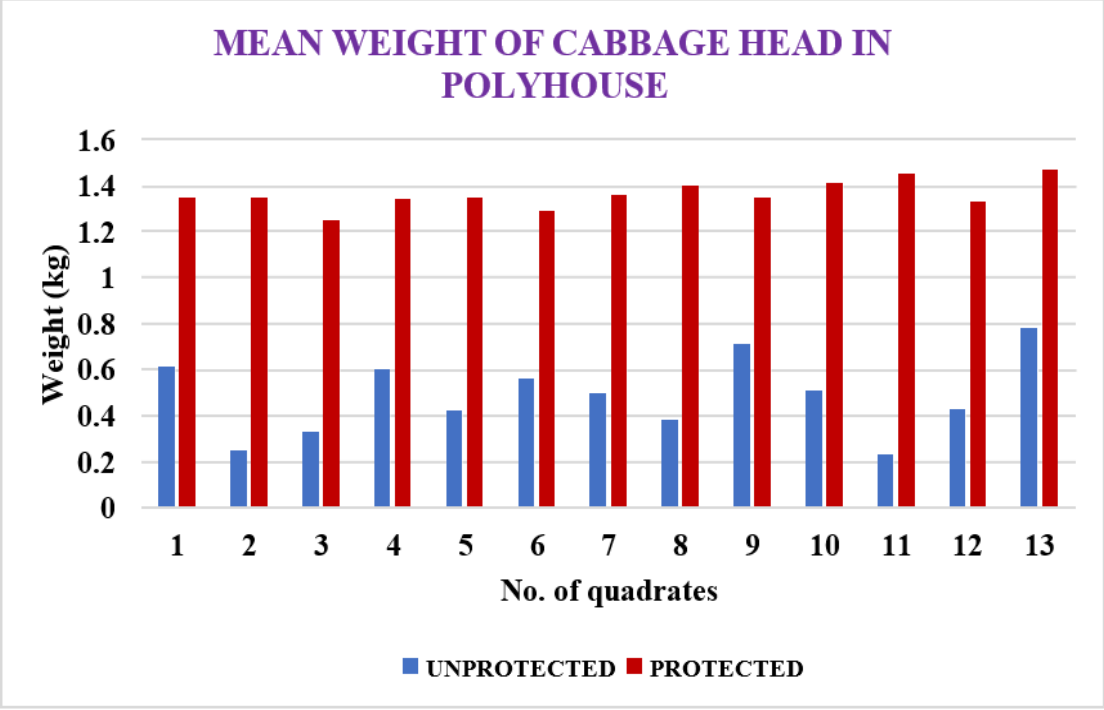

Fig. 2 Mean weight in protected and unprotected in Polyhouse *rabi*, 2022-23

Fig.3

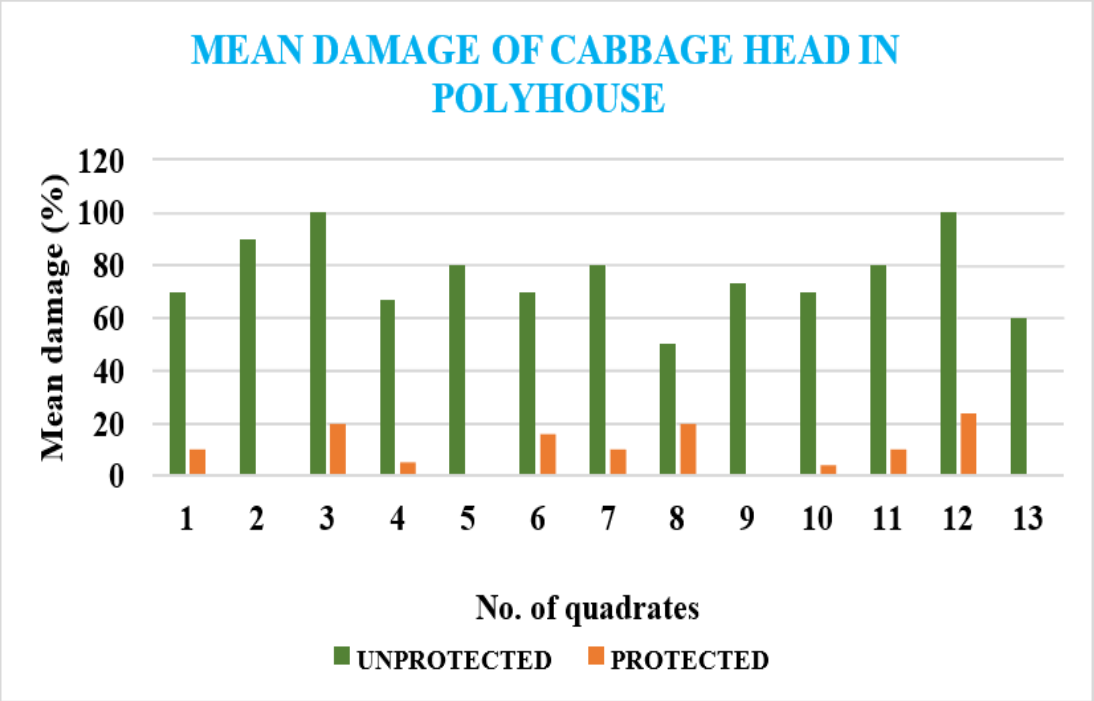

Fig. 3 Mean damage in protected and unprotected in Polyhouse *rabi*,2022-23

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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

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