

Original Research Article

Estimation of avoidable yield losses due to pest complex in cowpea [*Vigna unguiculata* (L.) Walp.]

ABSTRACT

A field experiment was conducted during the *Kharif* seasons of 2022 and 2023 at the research farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur, Rajasthan, India, to evaluate the yield losses caused by a pest complex on cowpea. The pooled study of both the year revealed that the highest total avoidable loss was observed in the untreated control (NP) at 40.90%, followed by the PVS treatment at 24.45%. The lowest avoidable loss was recorded in the PRS treatment at 13.49%. The treatment PTS showed the highest increase in cowpea seed yield over control, with a 69.24% increase, followed by PRS with a 46.29% increase. Conversely, the PVS treatment exhibited the lowest yield increase at 27.83%. The Maximum yield of 1049.70 kg ha⁻¹ was achieved with the PTS treatment, while the lowest yield of 620.40 kg ha⁻¹ was recorded in the NP treatment. The PVS and PRS treatments yielded 793.10 kg ha⁻¹ and 908.20 kg ha⁻¹, respectively.

Keywords: Pest complex, cowpea, yield losses, treatments.

1. INTRODUCTION

Cowpea [*Vigna unguiculata* (L.)] (Family: Leguminaceae) is one of the most important principle pulse crop of tropics and commonly known as crowdel pea, Chala, Chola or Choli, Chavli, Lobia, southern pea and black eyed bean. In Rajasthan, cowpea is grown on 79000 hectares area with 27000 metric tonnes production and average yield of 337 kg per hectare (Anonymous, 2022). The important insect species attacking But the cowpea crop are frequently attacked by aphid, *Aphis craccivora* Koch; jassid, *Empoasca fabae* (Harris); whitefly, *Bemisia tabaci* (Genn.); thrips, *Megaleurothrips distalis* Karny; and spotted pod borer, *Maruca vitrata* (Fab.) resulting in heavy yield losses (Prasad *et al.*, 1983 and Satpathy *et al.*, 2009). The spotted pod borer is one of the most important pests of cowpea and causes severe yield losses (up to 60%) in the tropics and sub tropics (Singh *et al.*, 1978). *Maruca vitrata* attacks cowpea during the reproductive phase. The female moth lays eggs on or near the flower buds (Sharma, 1998). The larvae of spotted pod borer are known to cause damage by webbing the leaves, bud, flower and pods together and feed inside them. The whitefly, *Bemisia tabaci* (Genn.), feeds on plant sap and excretes a sugary substance known as honeydew. This honeydew promotes the growth of sooty mold, which can significantly weaken plants and impair their ability to photosynthesize. Infested plants typically exhibit yellowing leaves and stunted growth. In addition to causing direct damage through feeding,

Comment [A1]: Insecticide ?

Comment [A2]: Add recent ref

whiteflies are also vectors for transmitting plant viruses (Gerling, 1990). The leafhopper, *Empoasca fabae*, feeds on the cell sap from the lower surface of leaves and injects toxic substances, leading to symptoms such as yellowing and curling of leaf margins, as well as stunted plant growth. Severe infestations can cause leaf burning and subsequent leaf drop, resulting in a significant decrease in yield ranging from 40 to 60 per cent (Narke and Suryawanshi, 1987).

Comment [A3]: Add objective. Why did you conducted this exp?

2. MATERIALS AND METHODS

The experiment was conducted using a simple Randomized Block Design (RBD). Cowpea genotype CPD-119 was evaluated to estimate avoidable losses due to a pest complex in cowpea, with each treatment replicated five times. Each treatment was sown in plots measuring 1.2 x 3 m², maintaining row to row and plant to plant distances of 30 cm and 10 cm, respectively. Treatments were

- T₁: Protection against insect pest throughout crop season (PTS).
- T₂: Protection against insect pest throughout vegetative stage (before flowering stage) (PVS).
- T₃: Protection against insect pests from flowering to harvesting stage (PRS).
- T₄: No protection against insect pests (NP).

Table 1. Details of treatments

Treatment	Insecticides	Dosage
T ₁	Imidacloprid 17.8 SL and chlorantraniliprole 18.5 SC	20g a.i./ha
T ₂	Imidacloprid 17.8 SL	20g a.i./ha
T ₃	Chlorantraniliprole 18.5 SC	20g a.i./ha
T ₄	Unprotected	-

* Imidacloprid 17.8 SL was applied 30 days after sowing and while chlorantraniliprole 18.5 SC was applied at the 50 per cent flowering stage.

The percentage of avoidable loss in cowpea seed yield was calculated separately for different protection levels based on the cowpea seed yield (kg/ha).

The yield data of cowpea seeds from protected and unprotected plots were recorded. The yield difference in protected plots over unprotected plots was calculated and the avoidable loss was determined using the following formula (Pradhan, 1964).

$$\text{Avoidable Loss (\%)} = \frac{\text{Yield in treated plot} - \text{Yield in untreated control plot}}{\text{Yield in treated plot}} \times 100$$

$$\text{Increase in yield (\%)} = \frac{\text{Yield in treated plot} - \text{Yield in untreated control plot}}{\text{Yield in untreated plot}} \times 100$$

Comment [A4]: d

Comment [A5]: Old

Comment [A6]: I

3. RESULTS AND DISCUSSION

3.1 Kharif, 2022

3.1.1 Yield

The yield of cowpea worked out separately in each treatment. From these data, yield of cowpea seed was converted to kg ha^{-1} and these data were analyzed.

Comment [A7]: Shift in mat and meth.

Significant differences were also observed among different treatments. The highest yield ($1054.60 \text{ kg ha}^{-1}$) was achieved in the treatment of PTS, whereas it was lowest ($631.80 \text{ kg ha}^{-1}$) in the treatment of NP. The yield of PVS and PRS treatments were 810.20 and $923.60 \text{ kg ha}^{-1}$, respectively. The descending order of treatments on the basis of total yield of cowpea seed was found to be $\text{PTS} > \text{PRS} > \text{PVS} > \text{NP}$.

3.1.2 Avoidable loss

The per cent avoidable loss in cowpea seed yield was worked out in different protection levels separately on the basis of cowpea seed yield (kg ha^{-1}).

Comment [A8]: Shift in mat and meth.

The results explicated that the highest avoidable loss was noticed in the treatment NP (40.09%) and it was followed by PVS (23.17%) treatment, whereas, it was lowest in the treatment of PRS (12.42 %). The descending order of treatments on the basis of per cent avoidable loss in cowpea seed yield was $\text{NP} > \text{PVS} > \text{PRS}$.

3.1.3 Per cent increase in seed yield of cowpea over control

Per cent increase in seed cowpea yield over control was worked out in different levels of protection on the basis of cowpea seed yield.

The overall increase in cowpea seed yield over control was maximum in treatment of PTS (66.92 %). It was followed by the treatment PRS (46.19 %). The minimum per cent increase in cowpea seed yield was observed in treatment of PVS (28.24%) as the crop was kept unsprayed during the most vulnerable stage *i.e.*, reproductive stage of cowpea. The descending order of different protection level based on per cent increase in cowpea seed yield over control was $\text{PTS} > \text{PRS} > \text{PVS}$ indicating the turn the order of effectiveness of these treatments.

3.2 Kharif, 2023

3.2.1 Yield

The yield of cowpea worked out separately in each treatment. From these data, yield of cowpea seed was converted to kg ha^{-1} and these data were analyzed.

Significant differences were also observed among different treatments. The highest yield ($1044.80 \text{ kg ha}^{-1}$) was achieved in the treatment of PTS, whereas it was lowest (609 kg ha^{-1}) in

the treatment of NP. The yield of PVS and PRS treatment was 776 and 892.80 kg ha⁻¹, respectively. The descending order of treatments on the basis of total yield of cowpea seed was found to be PTS > PRS > PVS > NP.

3.2.2 Avoidable loss

The per cent avoidable loss in cowpea seed yield was worked out in different protection levels separately treatments based on the basis of cowpea seed yield (kg ha⁻¹).

The results explicated that the highest avoidable loss was noticed in the treatment NP (41.71%) and it was followed by PVS (25.73%) treatment, whereas, it was the lowest in the treatment of PRS (14.55%). The descending order of treatments on the basis of percent avoidable loss in cowpea seed yield was NP > PVS > PRS.

3.2.3 Per cent increase in seed yield of cowpea over control

Per cent increase in cowpea seed yield over control was worked out in different levels of protection on the basis of cowpea based on seed yield.

The overall increase in cowpea seed yield over control was maximum in treatment of PTS (71.56%). It was followed by the treatment PRS (46.39%). The minimum per cent increase in cowpea seed yield was observed in treatment of PVS (27.42%) as the crop was kept unsprayed during the most vulnerable stage, i.e., reproductive stage of cowpea. The descending order of different protection level based on per cent increase in cowpea seed yield over control was PTS > PRS > PVS indicating the turn the order of effectiveness of these treatments.

3.3 Pooled (Kharif, 2022 and 2023)

3.3.1 Yield

The yield of cowpea worked out separately in each treatment. From these data, yield of cowpea seed was converted to kg ha⁻¹ and these data were analyzed.

Significant differences were also observed among different treatments. The highest yield (1049.70 kg ha⁻¹) was achieved in the treatment of PTS, whereas it was the lowest (620.40 kg ha⁻¹) in the treatment of NP. The yield of PVS and PRS treatments was 793.10 and 908.20 kg ha⁻¹, respectively. The descending order of treatments on the basis of total yield of cowpea seed was found to be PTS > PRS > PVS > NP.

3.3.2 Avoidable loss

The per cent avoidable loss in cowpea seed yield was worked out in different protection levels separately on the basis of cowpea seed yield (kg ha⁻¹).

The results explicated that the highest total avoidable loss was noticed in the treatment NP (40.90%) and it was followed by PVS (24.45%) treatment, whereas, it was the lowest in the

treatment of PRS (13.49%). The descending order of treatments on the basis of percent avoidable loss in cowpea seed yield was NP > PVS > PRS.

UNDER PEER REVIEW

Table: 2 Seed yield and avoidable losses due to pest complex in different protection levels in cowpea during *Kharif*, 2022 and 2023

S. No	Protection levels Times/Stages	Treatments	Seed yield (kg/ha)			Avoidable loss in cowpea seed yield (%)			Increase in cowpea seed yield over control (%)		
			2022	2023	Pooled	2022	2023	Pooled	2022	2023	Pooled
1.	Protection against insect pests throughout crop season (PTS).	Imidacloprid 17.8 SL and chlorantraniliprole 18.5 SC	1054.6	1044.8	1049.7	-	-	-	66.92	71.56	69.24
2.	Protection against insect pests throughout vegetative stage (before flowering stage) (PVS)	Imidacloprid 17.8 SL	810.2	776	793.1	23.17	25.73	24.45	28.24	27.42	27.83
3.	Protection against insect pests from flowering to harvesting stage (PRS)	Chlorantraniliprole 18.5 SC	923.6	892.8	908.2	12.42	14.55	13.49	46.19	46.39	46.29
4.	No protection against insect pests (control) (NP).	-	631.8	609	620.4	40.09	41.71	40.90	-	-	-
S.Em ±			34.57	36.15	36.91						
C.D. (P=0.05)			106.51	111.37	107.73						

3.3.3 Per cent increase in seed yield of cowpea over control

Per cent increase in cowpea seed yield over control was worked out indifferent levels of protection on the basis of cowpea seed yield.

The overall increase in cowpea seed yield over control was maximum in treatment of PTS (69.24%). It was followed by the treatment PRS (46.29 %). The Minimum per cent increase in cowpea seed yield was observed in treatment of PVS (27.83%) as the crop was kept unsprayed during the most vulnerable stage i.e., reproductive stage of cowpea. The descending order of different protection level based on per cent increase in cowpea seed yield over control was PTS > PRS > PVS indicating the turn the order of effectiveness of these treatments.

The results are agreement with those of Anusha and Balikai (2015) reported the apparent losses caused by pod borers and sucking pests in cowpea were 47.23 to 62.52 per cent. The present findings align with Kanhere *et al.* (2012), who reported an 84.25 per cent yield improvement in protected plots over the unprotected plots, with an avoidable loss of 45.73 per cent due to pod borer damage. Similarly, Duraimurugan and Tyagi (2014) was also reported 32.97 per cent yield losses in green gram. These results are also conformity with the findings of Shukla (2005) and Rathwa *et al.* (2018). The varied damage caused by major insect pests of cowpea was due to the varied biotic and abiotic factors of various localities.

4. CONCLUSION

The PTS treatment had the highest yield (1049.70 kg ha⁻¹), with the lowest in NP (620.40 kg ha⁻¹). The PVS and PRS treatments yielded 793.10 kg ha⁻¹ and 908.20 kg ha⁻¹, respectively. The highest total avoidable loss was in NP (40.90%) followed by PVS (24.45%), and the lowest in PRS (13.49%). The PTS treatment also showed the highest yield increase over control (69.24%) followed by PRS (46.29%), with PVS showing the lowest increase (27.83%).

REFERENCES

1. Anonymous. Agricultural Statistics of Rajasthan. Directorate of Economics and Statistics, Department of Planning, Rajasthan, Jaipur. 2022;96.
2. Anusha CH, Balikai RA. Avoidable loss estimation due to pod borers in C-152 and DC-15 varieties of cowpea. Journal of Experimental Zoology India. 2012;18(1):349-353.
3. Duraimurugan P, Tyagi K. Pest spectra, succession and its yield losses in mungbean and urdbean under changing climatic scenario. Legume Research. 2014;37:212-222.
4. Gerling D. Natural enemies of whiteflies: predators and parasitoids, Whiteflies: their bionomics. Pest status and management. Intercept Andover, United Kingdom. 1990;147-185.
5. Kanhere RD, Patel VN, Umbarkar PS. Estimation of yield losses caused by insect pests infesting cowpea. Insect Environment. 2012;17(4):182-183.

Comment [A9]: By which insecticides? Mention.

6. Narke CG, Suryawanshi DS. Chemical control of major pests of okra. *Pesticides*. 1987;21(1):37-42.
7. Pradhan S. Assessment of losses by insect pests of crops and estimation of insect population. *Entomology in India*. Entomology Society of India, New Delhi. 1964;17-58.
8. Prasad D, Singh KM, Katiyar R.N. Succession of insect pests in early maturing high yielding varieties of pea, *Pisum sativum* Linn. *Indian Journal of Entomology*. 1983;45(4):451-455.
9. Rathwa MG, Patel VN, Makwana AB. Estimation of yield losses due to spotted pod borer, *Maruca testulalis* in cowpea. *International Journal of Chemical Studies*. 2018;6(2):322-324.
10. Satpathy S, Shivalingaswami TM, Kumar A, Raj AB, Rai M. Efficacy of biopesticides and new insecticides for managements of cowpea pod borer, *Maruca vitrata*. Symposium on international conference on grain legumes: Quality improvement value addition and trade, held on February 14-16, 2009 at IIPR, Kanpur. 2009;292-293.
11. Sharma HC. Bionomics, host plant resistance and management of the legume pod borer, *Maruca vitrata*-a review. *Crop Protection*. 1998;17(5):373-386.
12. Shukla NP. Bionomics of spotted pod borer *Maruca vitrata* (Fabricius), pest succession and management of pest complex of cowpea. Ph.D. Thesis (unpublished) submitted to Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar; 2005.
13. Singh SR, Van Emden HF, Taylor TA. Resistance to pests of cowpea in Nigeria. *Pests of Grain Legumes: Ecology and Control*, London, New York: Academic press. 1978;414.