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 cowpea crop are aphid, *Aphis craccivora* Koch; jassid, *Empoasca fabae* (Harris); whitefly, *Bemisiatabaci* (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 boreris one of themost important pests of cowpea and causes severeyieldlosses(up to60%) 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 ofspotted pod borer are known to cause damage by webbing the leaves, bud, flower andpods together and feed inside them. The whitefly, *Bemisiatabaci* (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, 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).

2. MATERIAL 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

T_1:Protectionagainstinsectpeststhroughout cropseason (PTS).

T_2: Protectionagainstinsectpeststhroughoutvegetativestage(beforeflowering stage)(PVS).

T_3: Protection against insect pests from flowering to harvesting stage (PRS).

T_4:Noprotectionagainstinsectpests(NP).

Table 1. Details of treatments

Treatment	Insecticides	Dosage
T_1	Imidacloprid 17.8 SL and chlorantraniliprole18.5SC	20g *a.i.*/ha
T_2	Imidacloprid17.8 SL	20g *a.i.*/ha
T_3	Chlorantraniliprole18.5 SC	20g *a.i.*/ha
T_4	Unprotected	-

* Imidacloprid 17.8 SL was applied 30 days after sowing and 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 was recorded. The yield difference in protected plots over unprotected plots was calculated and the avoidable loss was determined using the following formula. (Pradhan,1964).

$$\textbf{AvoidableLoss}(\%) = \frac{\textbf{Yieldintreatedplot} - \textbf{Yieldin untreatedcontrolplot}}{\textbf{Yield intreatedplot}} \times \mathbf{100}$$

$$\textbf{Increaseinyield}(\%) = \frac{\textbf{Yieldintreatedplot} - \textbf{Yieldin untreatedcontrolplot}}{\textbf{Yield in untreatedplot}} \times \mathbf{100}$$

3. RESULTS AND DISCUSSION

3.1 *Kharif,* 2022

3.1.1 Yield

Theyieldofcowpea worked out separately ineach treatment. From thesedata,yieldofcowpeaseedwasconvertedtokg ha^{-1}andthesedatawereanalyzed.

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

3.1.2 Avoidable loss

The per cent avoidable loss in cowpea seed yield was worked out in differentprotectionlevelseparatelyonthebasisofcowpea seedyield(kg ha^{-1}).

The results explicated that the highest avoidable loss was noticed inthetreatmentNP(40.09%)anditwasfollowedbyPVS(23.17%)treatment,whereas, it was lowest in the treatment of PRS (12.42 %). The descending order oftreatments onthe basisof percent avoidableloss incowpea seedyieldwasNP >PVS > 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 indifferent levels of protection on the basis of cowpea seed yield.

The overall increase in cowpea seed yield over control was maximum intreatment of PTS (66.92 %). It was followed by the treatment PRS (46.19 %). Theminimum per cent increase in cowpea seed yield was observed in treatment of PVS(28.24%)asthecropwaskeptunsprayedduringthemostvulnerablestage*i.e.,*reproductive stage of cowpea. The descending order of different protection level basedon per cent increase in cowpea seed yield over control was PTS > PRS > PVS indicatingthe turn theorder ofeffectiveness ofthese treatments.

3.2*Kharif,* 2023

3.2.1 Yield

Theyieldofcowpea worked out separately ineach treatment. From thesedata,yieldofcowpeaseedwasconvertedtokg ha^{-1}andthesedatawereanalyzed.

Significant differences were also observed among different treatments.The highest yield (1044.80 kg ha^{-1}) was achieved in the treatment of PTS, whereas it was lowest (609 kg ha^{-1}) in thetreatment ofNP. The yield of PVS and PRS treatment was 776 and 892.80 kg ha^{-1}, respectively.The

descendingorder of treatments on the basis of total yield of cowpea seed was found to bePTS>PRS>PVS>NP.

3.2.2 Avoidable loss

The per cent avoidable loss in cowpea seed yield was worked out in differentprotectionlevelseparatelyonthebasisofcowpea seedyield(kg ha^{-1}).

The results explicated that the highest avoidable loss was noticed inthetreatmentNP(41.71%)anditwasfollowedbyPVS(25.73%)treatment,whereas, it was lowest in the treatment of PRS (14.55 %). The descending order oftreatments onthe basisof percent avoidableloss incowpea seedyieldwasNP >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 indifferent levels of protection on the basis of cowpea seed yield.

The overall increase in cowpea seed yield over control was maximum intreatment of PTS (71.56 %). It was followed by the treatment PRS (46.39 %). Theminimum per cent increase in cowpea seed yield was observed in treatment of PVS(27.42%)asthecropwaskeptunsprayedduringthemostvulnerablestage*i.e.,*reproductive stage of cowpea. The descending order of different protection level basedon per cent increase in cowpea seed yield over control was PTS > PRS > PVS indicatingthe turn theorder ofeffectiveness ofthese treatments.

3.3 Pooled (*Kharif,* 2022 and 2023)

3.3.1 Yield

Theyieldofcowpea worked out separately ineach treatment. From thesedata,yieldofcowpeaseedwasconvertedtokg ha^{-1}andthesedatawereanalyzed.

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 lowest (620.40 kg ha^{-1}) in thetreatment ofNP. The yield of PVS and PRS treatments was 793.10 and 908.20 kg ha^{-1}, respectively.The descendingorder of treatments on the basis of total yield of cowpea seed was found to bePTS>PRS>PVS>NP.

3.3.2 Avoidable loss

The per cent avoidable loss in cowpea seed yield was worked outdifferentprotectionlevelseparatelyonthebasisofcowpea seedyield(kg ha^{-1}).

The results explicated that the highest total avoidable loss was noticed inthetreatmentNP(40.90%)anditwasfollowedbyPVS(24.45%)treatment,whereas, it was lowest in the treatment of PRS (13.49 %). The descending order oftreatments onthe basisof percent avoidableloss

incowpea seedyieldwasNP >PVS > PRS.

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	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.	Protectionagainstinsectpeststhroughout cropseason (PTS).	Imidacloprid 17.8 SL and chlorantraniliprole18.5SC	1054.6	1044.8	1049.7	-	-	-	66.92	71.56	69.24
2.	Protectionagainstinsectpeststhroughoutvegetativestage(beforeflowering stage)(PVS)	Imidacloprid17.8 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)	Chlorantraniliprole18.5 SC	923.6	892.8	908.2	12.42	14.55	13.49	46.19	46.39	46.29
4.	Noprotectionagainstinsectpests (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 intreatment of PTS (69.24 %). It was followed by the treatment PRS (46.29 %). Theminimum per cent increase in cowpea seed yield was observed in treatment of PVS(27.83%)asthecropwaskeptunsprayedduringthemostvulnerablestage*i.e.,*reproductive stage of cowpea. The descending order of different protection level basedon per cent increase in cowpea seed yield over control was PTS > PRS > PVS indicatingthe turn theorder ofeffectiveness ofthese 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%).

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