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IMPACT OF TREADMILL APPLICATION OF INSECTICIDES ON PODS DAMAGE OF *CAJANUS CAJAN* LANDRACES

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ABSTRACT

Impact of treadmill application of insecticides on pods damage of *C. cajan* landraces was evaluated in the field trial on Jawahar Model, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India. The field trial was conducted from June 2022 to June 2023. The experiment was laid out in Split plot design with three main plots (M_1 - Chlorantraniliprole 18.5% SC followed by Emamectin benzoate 5% SG, M_2 - E. benzoate 5% SG followed by E. benzoate 5% SG and M_3 - Control) and six sub plots were landraces of *C. cajan* treatments (S_1 - Korsar 1, S_2 - Korsar 2, S_3 - Amarkantak 3, S_4 - Burhanpur 1, S_5 - Lakhnadon 1 and S_6 - TDN 1) during *Kharif-Rabi* season 2022-23. Mature pods were harvested by two handpicking and counted on per plant basis. Hand picking was done when nearly 80 percent of the pods had signs of maturity. The 1st picking was done from the 3rd week of December 2022 to 1st week of January 2023 while the 2nd picking was done from the 4th week of March to 1st week of April 2023. The mean number of total pods per plant in the interaction of insecticides and different landraces varied from M_3S_3 (4714) to M_2S_1 (8940.67).

Key words : Treadmill application, Chlorantraniliprole 18.5% SC, Emamectin benzoate 5% SG, *Cajanus cajan* and *Kharif-Rabi* season.

Introduction

Major insect pests of *C. cajan* are pod borers (Das *et al*., 2015) and contact insecticides are generally recommended (Taggar *et al*., 2021; Patel *et al*., 2024; Smridhi *et al*., 2023). In contrast to the borer's pest of *C. cajan*, the lac insects being phloem feeders, use of contact insecticides are recommended to protect it from its predators and parasitoids (Janghel *et al*., 2014; Khichi and Kumawat, 2021). Use of contact insecticides on *C. cajan* by a few farmers are a common-practices (Taggar *et al*., 2021). However, due to their socio-economic status, only a few well-off lac growers use insecticides to protect their lac crop. Thus, repeated use of the same insecticides by *C. cajan* farmers (Gross and Rosenheim, 2011) and lac growers (Janghel, 2013) are common. Repeated use of the same insecticides at short intervals is termed as "Treadmill phenomena". Treadmill phenomena is reported by across the countries (Gross *et al*., 2011). It is one of the many reasons for development of insecticides resistance (Williamson *et al*., 2015). The commonly used contact insecticides in Madhya Pradesh are emamectin benzoate (Janghel *et al*., 2014) and chlorantraniliprole (Chawan *et al*., 2020). As mentioned, treadmill phenomena through it is known to many but due to lack of reliable data on sequential application of contact insecticides (Belay and Azerefegne, 2021), it is difficult to discourage the practices. In this context, the present

study "Impact of treadmill application of insecticides on pods damage of *C. cajan* landraces" were conducted.

Materials and Methods

Experimental details

Impact of treadmill application of insecticides on pods damage of *C. cajan* landraces was evaluated in the field trial in Jawahar Model, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh. The field trial was conducted from June 2022 to June 2023. The experiment was laid out in Split plot design with three main plots ($\mathbf{M_1}$ - Chlorantraniliprole 18.5% SC followed by E. benzoate 5%SG, $\mathbf{M_2}$ - E. benzoate 5%SG followed by E. benzoate 5%SG and $\mathbf{M_3}$ – Control) and six sub plots were landraces of *C. cajan* treatments ($\mathbf{S_1}$ – Korsar 1, $\mathbf{S_2}$ – Korsar 2, $\mathbf{S_3}$ – Amarkantak 3, $\mathbf{S_4}$ – Burhanpur 1, $\mathbf{S_5}$ – Lakhnadon 1 and $\mathbf{S_6}$ – TDN 1) during *Kharif-Rabi* season 2022-23.

Layout of the main field

The layout of the experiment was planned in the main field to accommodate 54 *C. cajan* plants. The spacing between plant to plant and row to row in the main field was six feet apart. The spacing of 10 feet between replications was maintained (Khichi *et al*., 2021).

Poly propylene bag (PPB)

Each empty PPB purchased from local manufacturer weighed 85g and had a dimension of 95cm x 55cm. The substrate was filled into the PPB with the help of a *tasala* and by constant shaking the bag to ensure proper settlement and compactness. The 45kg in 2:1 *Kapu* (30kg) and FYM (15kg) substrate filled PPB reaches a dimension of 40cm height and 120cm circumference. The filled substrate filled PPBs with substrate were put on the designated spot in the layout of the experiment, such that it is not disturbed in future (Kakade *et al*., 2020).

Table 1 : Pesticides spray schedule.

Dates	M_1	M_2	M_3
20.11.22	Chlorantraniliprole	Emamectin benzoate	Water spray
20.12.22	Emamectin benzoate	Emamectin benzoate	Water spray
19.01.23	Chlorantraniliprole	Emamectin benzoate	Water spray
18.02.23	Emamectin benzoate	Emamectin benzoate	Water spray
20.03.23	Chlorantraniliprole	Emamectin benzoate	Water spray
19.04.23	Emamectin benzoate	Emamectin benzoate	Water spray

Treatment of the substrate

The PPB with substrate was then treated with soil microbes (*Trichoderma viride*, *Rhizobium*, *PSB*) produced by the microbe production unit of JNKVV, Jabalpur, Madhya Pradesh.

Results and Discussion

Effect of insecticides on pod yield of *C. cajan* landraces

Mature pods were harvested by first handpicking and counted on per plant basis. The pods were segregated for healthy and damage pods. There were two hand pickings. Two of the landraces (S_1 and S_2) were late maturing hence had only one picking while the rest four had two pickings. The mean number of healthy pods per plant due to the interactions of insecticides and landraces varied from 2700.00 (M_3S_5) to 3161.67 (M_1S_3). There was no significant difference to among all the treatments. Similarly recorded by earlier workers the mean number of healthy pods per plant of *C. cajan* in Jawahar model condition were 2981.89 to 2558.33 (Jethu, 2022).

The mean number of damaged pods in first handpicking per plant due to the interaction of insecticides and landraces varied from 106.67 (M_2S_6) to 266.67 (M_3S_4). There was no significant difference to among all the interactions. It was interesting to note that during the first picking, there was no significant difference among the interactions in terms of number of damaged pods per plant. Similarly recorded by earlier workers the mean number of damaged pods per plant of *C. cajan* in Jawahar model condition were 131.67 to 558.33 (Jethu, 2022).

During the second picking all the six landraces were harvested. In comparison to the first picking the mean number of healthy pods per plant were almost double during the second picking. The mean number of healthy pods per plant in the interaction of insecticides and different landraces varied from 1745.00 (M_3S_5) to 8940.67 (M_2S_1). It was significantly higher in M_2S_1 than M_3S_5 but at par with M_1S_1 (8901.67). The mean number of healthy pods in M_3S_2 (8433.00) was at par with M_3S_1 (8613.33), M_1S_2 (8756.33) and M_2S_2 (8853.33). Unlike that in the 1st picking, there was a significant difference in the mean number of healthy pods per plant among interactions. The interaction M_2S_1 and M_1S_1 had highest number of healthy pods per plant. Similarly recorded by earlier workers the mean number of healthy pods per plant of *C. cajan* in Jawahar model condition were 1730.67 to 1843.89 (Jethu, 2022).

In comparison to the 1st picking, the mean number of damaged pods per plant during the 2nd picking was more. The mean number of *C. cajan* damaged pods per plant in the interaction of insecticides and different landraces varied from 104.67 (M_3S_3) to 416.67 (M_1S_2). The latter had M_1S_2 was significantly higher mean number of

Table 2 : Mean number of healthy and damaged pods on *C. cajan* (1st and 2nd picking).

Mean number of pods/*C. cajan*					
Treatments	**1st picking**		**2nd picking**		**Total pods**
	Health	**Damaged**	**Healthy**	**Damaged**	
Main plot effect					
M_1	2014.83	154.39	4306.11	242.39	6320.94
M_2	2022.89	84.33	4309.94	178.50	6332.83
M_3	1843.17	151.78	4065.89	234.00	5909.06
SEm(±)	**11.02**	**9.63**	**8.45**	**9.45**	**12.06**
CD (5%)	**43.27**	**37.81**	**33.16**	**37.12**	**47.35**
Sub plot effect					
S_1	00.00	00.00	8818.56	371.44	8818.56
S_2	00.00	00.00	8680.89	352.11	8680.89
S_3	2999.33	194.89	2025.11	135.78	5024.44
S_4	2899.11	212.33	1964.78	140.00	4863.89
S_5	2884.67	193.67	1938.89	154.00	4823.56
S_6	2978.67	180.11	1935.67	156.44	4914.34
SEm(±)	**9.92**	**11.33**	**14.27**	**11.34**	**20.59**
CD(5%)	**28.64**	**32.71**	**41.22**	**32.76**	**59.46**
Interaction effect					
M_1S_1	00.00	00.00	8901.67	394.33	8901.67
M_1S_2	00.00	00.00	8756.33	416.67	8756.33
M_1S_3	3161.67	250.00	2130.00	178.33	5291.67
M_1S_4	2944.00	238.67	2006.67	152.67	4950.67
M_1S_5	2947.00	229.00	2016.33	159.67	4963.33
M_1S_6	3036.33	208.67	2025.67	152.67	5062
M_2S_1	00.00	00.00	8940.67	310.00	8940.67
M_2S_2	00.00	00.00	8853.33	286.67	8853.33
M_2S_3	3034.67	122.67	2033.00	124.33	5067.67
M_2S_4	3000.67	131.67	2015.67	113.33	5016.34
M_2S_5	3007.00	145.00	2055.33	130.00	5062.33
M_2S_6	3095.00	106.67	1961.67	106.67	5056.67
M_3S_1	00.00	00.00	8613.33	410.00	8613.33
M_3S_2	00.00	00.00	8433.00	353.00	8433
M_3S_3	2801.67	212.00	1912.33	104.67	4714
M_3S_4	2752.67	266.67	1872.00	154.00	4624.67
M_3S_5	2700.00	207.00	1745.00	172.33	4445
M_3S_6	2804.67	225.00	1819.67	210.00	4624.34
SEm(±)	**810.64**	**61.31**	**1865.33**	**65.30**	**1063.87**
CD(5%)	**2341.30**	**177.07**	**5387.47**	**188.61**	**3072.67**

damaged pods per plant than M_3S_3 but was at par with M_3S_1 (410.00). The mean number of damaged pods per plant in M_2S_1 (310.00) was at par with M_3S_2 (353.00) and M_1S_1 (394.10). In comparison to all interactions of the mean number of *C. cajan* damaged pods per plant M_3S_3 (104.67) was best in the 2nd picking. Whereas in 1st picking M_2S_2 (106.67) was best in comparison to all

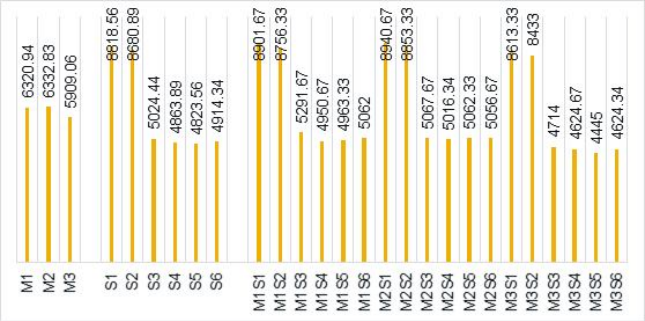

Fig. 1 : Mean number of total pods (MNTP) per plant of *C. cajan*.

interactions of the mean number of *C. cajan* damaged pods per plant. Similarly recorded by earlier workers the mean number of pods per plant of *C. cajan* in Jawahar model condition were 137.67 to 883.33 (Jethu, 2022).

Mean number of total pods (MNTP) per plant of *C. cajan* (included both 1st and 2nd picking healthy pods)

Mature pods were harvested by two handpicking and counted on per plant basis. Hand picking were done when nearly 80 percent of the pods had signs of maturity. The 1st picking was done from the 3rd week of December 2022 to 1st week of January 2023 *i.e.* 60 to 75 day after BLI, while the 2nd picking was done from the 4th week of March to 1st week of April 2023 *i.e.* 150 to 165 days after BLI. The mean number of total pods per plant in the interaction of insecticides and different landraces varied from M_3S_3 (4714) to M_2S_1 (8940.67). Similarly recorded by earlier workers the mean number of total pods per plant of *C. cajan* were 2454 to 2514 (Singh *et al*., 2009).

Conclusion

There was pod fly (*Malangromyza obtusa*), pod bug (*Clavigralla scutellaries*), plum moth (*Pterophoridae pentadactyla*), blister beetle (*Mylabris pustulata*) insect pests observed on the *C. cajan* during the experiment (Das *et al*., 2015; Janghel *et al*., 2014 and Khichi and Kumawat, 2021). The control insecticides were sprayed to protect lac insects from its predators and parasitoids. However, in the process of protecting lac insects, the contact insecticides application also favoured insect pest injury to the pods. Many earlier workers have used insecticides for management of insect pest in *C. cajan* (Das *et al*., 2015). Chlorantraniliprole used by Chawan *et al.* (2020); Nelson *et al.* (2021) and Khichi and Kumawat (2021), while emamectin benzoate was used by Bengochea *et al.* (2014) and Dash *et al.* (2015). The sequential application of chlorantraniliprole followed by emamectin benzoate (M_1) and emamectin benzoate followed by emamectin benzoate (M_2) had

different impact on the yield of the healthy pods over the control (M_3) treatment. There was two picking from four (S_3, S_4, S_5, S_6) of the six landraces. The landraces S_1 (Korsar 1) and S_2 (Korsar 2) having late podding types had only one picking.

Authors' contributions

Dhruv Kumar Patel led the conception and design of the study, conducted the primary data collection, and was chiefly responsible for the comprehensive analysis and interpretation of the data. He also took the lead in drafting and writing the manuscript. **R.S. Marabi** and **Moni Thomas** made significant contributions to the development of the manuscript by assisting with key sections and providing critical datasets and analytical tools essential to achieving the study's objectives. **Dhruv Kumar Patel, Deepak Singh** and **Shradha Parmar** collaboratively conducted in-depth statistical and thematic analyses, playing a vital role in interpreting the results and refining the study's data-driven insights.

Declaration

The authors declare that there are no conflicts of interest.

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