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Effect of insecticides and biorationals against pod bug (*Clavigralla gibbosa*) in pigeonpea

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Pigeonpea [*Cajanus cajan* (L.) Millsp.] is an important pulse crop in semi-arid tropics and sub-tropical areas of the world. In India, Gulbarga district is identified as pulse bowl of Karnataka state accounting 3.50 to 3.75 lakh hectares of area with average production per unit area which is less than the national average. Among the biotic stresses insects play a major role in reducing the yield of pigeonpea. More than 250 species of insects have been found feeding on pigeonpea, of which only a few of these cause significant and consistent damage to crop. The important pests include, the pod borer, *Helicoverpa armigera* (Hubner), spotted pod borer, *Maruca vitrata* (Geyer), pod bug, *Clavigralla gibbosa* (Spinola) and pod fly, *Melonagromyza abtusa* (Malloch) are the major pest species causing significant damage to pods. Among the pod damaging insect pests of pigeonpea, next to pod borers, pigeonpea pod sucking bug, *Clavigralla gibbosa* (Spinola) is the most important pest in India inflicting heavy loss to seed yield. The pod bug damage recorded 25 to 40% damage in pigeonpea (Adati *et al.* 2007). Further they reported that pod and grain weight were reduced by as much as 27 and 30 times respectively at a density of 12 nymphs/plant. Further, they also reported an economic threshold of one nymphs/ plant and an economic injury level of two nymphs/plant. The pest is a major factor responsible for shriveled or deformed seeds and cause heavy loss in early and medium late maturing pigeonpea genotypes (Nath *et al.* 2008).

In recent years pod bug, *C. gibbosa* is a real threat to quality grain production in pigeonpea. The pest has assumed to be causing major economic loss in early and medium late pigeonpea cultivars. Both nymphs and adults of the pod bug suck the sap from pods, grains, flowers and flower buds. The punctured pods exhibit reddish brown to dark brown patches on the surface of pods and premature drying of pods is noticed. When such pods are opened, shriveled and malformed seeds are observed. Further such seeds are easily succumbed to secondary infection by fungal disease and pose problems in post harvesting processes. The main reason for outbreak of the pest is due to continuous and indiscriminate use of same insecticide, monocropping and introduction of early and extra early maturing pigeonpea genotypes (Bharathimeena and Sudharma 2009, Hanumanthaswamy *et al.* 2009). Further *C. gibbosa* has emerged as one of the major pest in pigeonpea due to favourable temperature and humidity condition during reproductive stage of the crop (Singh *et al.* 2008). Under these circumstances the investigation on pigeonpea pod bug needs to be strengthened as the pest is new to this crop and the research studies in Karnataka are very meagre. Keeping this point in view, present study was undertaken to study the effect of insecticides and biorationals against pod bug, *Clavigralla gibbosa* (Spionla) in pigeonpea during *kharif* 2009–10 and 2010–11 at Agricultural Research Station, Gulbarga, Karnataka.

The field experiment was laid out in randomized block design at Agricultural Research Station, Gulbarga during 2009–10 and 2010–2011 to assess the efficacy of different insecticides, botanicals and bio-pesticides for management of pod bug, *C. gibbosa.* The experiment was replicated thrice with 11 treatments including an untreated control (Table 1). All the package of practices were followed, except for the management of pigeonpea pod bug. For the management of *Helicoverpa armigera*, the manual collection and repeated spraying of HaNPV @ 250 LE /ha was used to suppress *H. armigera* population at weekly interval to know the real efficacy of treatments against pod bugs and the details of the different treatments are presented in Table 1. The treatments

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Table 1 Efficacy of insecticides and biorationals against pod bug, *C. gibbosa* on pod and yield parameter of pigeonpea

Treatments	Dosage	Per cent pod damage			Per cent grain damage			Grain yield (tonnes/ha)		
	(ml/liter)	2009–10	2010–11	Pooled	2009–10	2010–11	Pooled	2009–10	2010–11	Pooled
Indoxacarb 14.5 SC	0.30 ml	42.25 –40.54	36.5 –37.17	39.38 –38.87	24.5 –29.67	26.14 –30.75	25.32 –30.21	0.76	0.812	0.786
Spinosad 45 SC	0.10 ml	31.25 –33.99	30.14 –33.3	30.69 –33.64	19 –25.84	22.64 –28.41	20.82 –27.15	0.737	0.837	0.787
Emamectin benzoate 5 SG	0.20 g	33.5 –35.37	31.43 –34.1	32.47 –34.74	20.25 –26.74	23.44 –28.96	21.84 –27.86	0.724	0.852	0.788
Rynaxypyr 18.5SC	0.15 ml	35 –36.27	32.3 –34.64	33.65 –35.46	15.5 –23.19	20.19 –26.7	17.85 –24.99	0.774	0.845	0.809
Methomyl 40SP	1.0 g	12.25 –20.49	14.68 –22.53	13.47 –21.53	5.5 –13.56	7.2 –15.56	6.35 –14.59	0.105	1.164	1.11
Acephate 75SP	1.0 g	18.5 –25.47	18.52 –25.49	18.51 –25.48	6.75 –15.06	8.45 –16.89	7.6 –16	0.95	1.06	1.005
Chlorpyriphos 20 EC	2.5 ml	16.5 –23.96	17.34 –24.61	16.92 –24.29	7.75 –16.17	9.73 –18.18	8.74 –17.2	0.998	1.04	1.019
Dimethoate 30 EC	1.7 ml	24 –29.33	21.73 –27.79	22.87 –28.57	13.75 –21.77	16.79 –24.19	15.27 –23	0.813	0.925	0.869
NSKE	5%	31 –33.83	27.3 –31.5	29.15 –32.68	19.5 –26.21	21.28 –27.47	20.39 –26.84	0.72	0.781	0.75
Verticillium lecanii	1×10^{10} conidia	35.25 –36.42	32.45 –34.73	33.85 –35.58	21.5 –27.63	24.26 –29.51	22.88 –28.58	0.689	0.75	0.72
Control		43.75 –41.41	37.37 –37.68	40.56 –39.56	25 –30	26.45 –30.95	25.72 –30.47	0.466	0.512	0.489
CD (P=0.05)		3.8	2.75	3.28	2.99	2.8	2.89	0.084	0.093	0.089
SEm±		11.37	8.24	9.8	8.94	8.36	8.63	0.252	0.279	0.265

Figures in parentheses are angular transformed values

were imposed twice with first application at tender pod stage followed by second spray after 15 days. Observations were recorded at harvest for both pod and grain damage from five randomly selected plants from each plot. For pod damage all the pods of five selected plants were assessed. Hundred pods were selected randomly among the pods of five plants for estimating grain damage (Table 1). The per cent pod and grain damage, grain yield/plot recorded and computed grain yield to q/ha and later subjected to statistical analysis. Further cost economics was worked out based on the grain yield, gross returns and total cost (Table 2).

The pooled data on efficacy of different insecticides, botanicals and a bio-pesticide against pod bug revealed that methomyl 40SP @ 1.0 g/l registered lowest pod damage (13.47%), seed damage (6.35%) and highest grain yield (11.10 q/ha) with highest net return (₹ 27 686/ha) and B:C ratio (1:4.54) indicating superiority of the treatment over rest of the treatments (Table 1 and 2). This is mainly because Methomyl had both insecticidal and ovicidal action against pod bug (Vinothkumar and Durairaj 2008). The next best treatments were acephate 75SP at 1.0 g/l and chlorpyriphos 20EC in recording lower pod damage, grain damage and higher grain yield (tonnes/ha), net returns and B:C ratio. The present findings corroborates with the results of Singh and Paras Nath (2011). On the contrary, new molecules such as indoxacarb 14.5 SC @ 0.3 ml/l, emamectin benzoate 5SG @ 0.2 g/l, spinosad 45SC @ 0.1 ml/l and rynaxypyr 18.5SC @ 0.15 ml/l were found totally ineffective in reducing the bug population as these new molecules are highly specific to lepidopterans rather than hemipteran bugs. Interestingly, new molecules are highly effective against *Helicoverpa armigera* because of chewing and biting type of mouth parts and secondly new molecules are strong stomach poisons. Pod bugs never come in contact with new molecules as they suck the sap directly from the tender seeds by piercing its proboscis directly into pods. Considering the type of mouthparts, feeding habit and nature of damage, contact insecticides are more effective against bugs than stomach and systemic insecticides. Similarly, systemic insecticide such as dimethoate 30EC is also not enough to make the entire seed to become lethal to the bugs as these bugs directly pierce their proboscis into tender pods and suck the milky juice from tender seeds thereby seeds become shriveled and deformed. Secondly it is impossible to make the entire seed poisonous that is enough to kill the bugs. There were no earlier reports available with above treatments for comparison. All the above findings seem to be the first of its kind (Table 1 and 2).

Table 2 Cost economics of different insecticides and biorationals against pod bug, *C. gibbosa*

Treatment	Dosage (ml/liter)	Grain yield (tonne/ha)	Gross returns (₹)	Spray cost (₹)	Other costs (₹)	Total cost (₹)	Net returns (₹)	B:C Ratio
Indoxacarb 14.5 SC	0.30 ml	0.786	25 163	1 080	7 150	8 230	16 933	3.06
Spinosad 45 SC	0.10 ml	0.787	25 174	1 400	7 150	8 550	16 624	2.94
Emamectin benzoate 5 SG	0.20 g	0.788	25 226	1 120	7 150	8 270	16 956	3.05
Rynaxypyr 18.5SC	0.15 ml	0.809	25 898	1 140	7 150	8 290	17 608	3.12
Methomyl 40SP	1.0 g	1.110	35 506	670	7 150	7 820	27 686	4.54
Acephate 75SP	1.0 g	1.005	32 149	650	7 150	7 800	24 349	4.12
Chlorpyriphos 20 EC	2.5 ml	1.019	32 608	774	7 150	7 924	24 684	4.12
Dimethoate 30 EC	1.7 ml	0.869	27 810	560	7 150	7 710	20 100	3.61
NSKE	5 %	0.750	24 012	600	7 150	7 750	16 262	3.10
Verticillium lecanii	1×10^{10} conidia	0.720	23 038	500	7 150	7 650	15 388	3.01
Control	-	0.489	15 648	0	7 150	7 150	8 498	2.19

Price of pigeonpea grains: ₹ 3 200/tonne; B:C ratio= Gross returns(₹)/Total cost (₹)

During rapid roving survey from 2002 to 2011, it was noticed that where ever farmers sprayed new molecules continuously for 4 to 5 times especially indoxacarb and spionsad against *Helicoverpa armigera*, there was increase in the bug population indicating ineffectiveness of new molecules as they are highly selective and effective against lepidopteran pod borers rather than pod bugs. Secondly, there was reduction in the use of broad spectrum insecticides such as methomyl 40 SP, acephate 75 SP and chlorpyriphos 20 EC may be another reason for increase in pod bug incidence in pigeonpea. Similar results were obtained with Singh *et al.* (2008) who reported that synthetic insecticides are effective in reducing the bug population. Interestingly, fields sprayed with chlorpyriphos, methomyl and acephate were totally free from pod bugs and fields where sprayed with both broad spectrum insecticides and new molecules in rotation were free from both pod borers and pod bugs. Further, NSKE 5% and and *Verticillium lecanii* were found to be less effective. Similar results were obtained by Nath *et al*. (2008), Srinivasan and Sridhar (2008), Bharathimeena and Sudharma (2009), Hanumanthaswamy *et al*. (2009) who reported that Neem extract and bioagents were not as effective as the synthetic insecticides. From the on going discussion, it can be concluded that broad spectrum insecticides such as methomyl 40SP, acephate 75SP and chlorpyriphos 20EC have to be rotated at least once or twice with new molecules for successful management of both pod borers and pod bug population in pigeonpea.

SUMMARY

An investigation was undertaken to study the effect of insecticides and biorationals against pod bug, *Clavigralla gibbosa* (Spinola) in pigeonpea at Agricultural Research Station, Gulbarga, Karnataka, India during *kharif* 2009-10 and 2010-11. The study was conducted under field conditions with different insecticides, botanicals and a bio-pesticide for their efficacy against pod bug, *C. gibbosa.* The results revealed that methomyl 40 SP @ 1.0 g/l was found to be significantly superior followed by chlorpyriphos 20 EC @ 2.5 ml/l and acephate 75 SP @ 1.0 g/l indicating that broad spectrum insecticides are effective in suppressing the pod bug population and recorded higher grain yield with higher net profit and B: C ratio. On the contrary, new molecules such as Indoxacarb 14.5 SC @ 0.3 ml/l, spinosad 45 SC @ 0.1 ml/l, emamectin benzoate 05SC @ 0.2 g/l, rynaxypyr 18.5 SC @ 0.15 ml/l and *Verticillium lecanii* @ 1×10^{10} conidia were found ineffective in reducing pod bug population. Where as insecticides, viz dichlorvos 76 EC @ 0.5 ml/l and NSKE (5%) were moderately effective in minimizing the pod bug population. Thus, it can be concluded that broad spectrum insecticides such as methomyl 40SP, acephate 75SP and chlorpyriphos 20EC have to be rotated at least once or twice with new molecules which are selective and highly effective against lepidopteran pod borers rather than pod bugs for successful management of both pod borers and pod bug population in pigeonpea.

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