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Integrated Management of Pod Borer, *Helicoverpa armigera* on Pigeonpea [*Cajanus cajan* (L.) Millsp]

Key words : Integrated pest management, Pigeonpea, Pod borer

Pigeonpea (*Cajanus cajan*) is an important pulse crop of India. The major limiting factor in its productivity is the damage caused by insect pests especially pod borer complex *viz., Helicoverpa armigera*, *Exelastis atomosa* and *Melanagromyza obtusa* which cause upto 70-80% losses during epidemic years and the losses due to *H.armigera* alone extend upto 40% (Adgokar *et.al.,* 1993). More reliance on chemical methods to contain these pests have resulted in other side effects like development of resistance in insects, environmental pollution, health hazards to man. This led to the growing awareness of ecofriendly approaches like integrated pest management (IPM). Integrated management of pod borer through combination approaches like use of botanicals (neem products), bird perches, pheromone traps, nuclear polyhedrosis virus (NPV) and manipulation in cultural methods with varying degrees of success in pigeonpea. IPM components resulted in 46% reduction in pod damage in IPM plots as against control plots where one neem, one HaNPV, (*Helicoverpa* NPV), one manual shaking and one chemical spray were applied. Individual treatments such as shaking alone, neem, HaNPV and insecticide spray applied at 15 days interval from flower initiation resulted in 30, 33, 28 and 37% reduction in pod damage respectively (Ranga Rao *et. al.,* 2005). The present study was conducted to study the utility of integrated approach over farmers' practice.

Field experiment (observational trial) was conducted in the Agricultural Research Station, Warangal to test the utility of integrated approach for pod borer management for four years during *Kharif,* 2002 to 2005 in deep black soils. The experiment was conducted in pigeonpea - maize intercropping system in 1:2 ratio with plot size varying between 400-1000 sq.m. and spacing of 135 cm x 20 cm in pigeonpea. Two rows of maize were grown in between two pigeonpea rows at spacing of 45cm x 20cm. All recommended practices were adopted except plant protection measures. Treatmens were laid out in 4 modules–Integrated pest management in resistant variety (WRG 27), IPM in susceptible variety (ICPL 87119), farmers' practice and unprotected control. During *Kharif*, 2002, IPM module was imposed in the variety ICPL 87119 (Asha) against unprotected plot of the same variety. During *Kharif*, 2003, IPM module was tested in the variety WRG-27 against farmers' practice. Asha was chosen as the test variety in farmers' practice and unprotected set throughout the study period. However, during the subsequent 2 years (*Kharif*, 2004 and 2005), IPM module was tested in both WRG-27, Asha varieties. Components of IPM module included growing guard crop (sorghum) surrounding the plot, clipping of growing tips when the crop is at bud initiation phase (90-110 days after sowing) depending on soil moisture, monitoring pest population especially *H.armigera* through installation of pheromone traps, erection of T-shaped bird perches, spraying of botanicals (neem oil/neem seed kernel extract), nuclear polyhedrosis virus, mechanical shaking of plants to remove later instars, need based spraying of insecticide. These components were imposed as per the need. Therefore, components imposed in different seasons varied according to the prevailing pest situation (Table 1). In farmers' practice, two sprays were taken up – the first spray at bud initiation (Endosulfan @ 2 ml/lt) and second spray at 50% flowering (Chlorpyriphos @ 2.5 ml/lt). No plant protection measures were taken up in unprotected plot (Control).

Observations were recorded on *H.armigera* at peak flowering and pod development stage on 10 randomly selected plants from each plot leaving border rows. Per cent pod damage was recorded at the time of harvest by counting number of healthy and damaged pods on 5 randomly selected plants in each plot. Plot yield was taken and economics were calculated arriving at Incremental Benefit : Cost ratio.

The incidence of *Helicoverpa armigera* (oviposition and larval abundance) and per cent pod damage by the pod borer was given in Table 2. The number of eggs per plant in all the modules/treatments were higher at peak flowering stage (1.44 -12.0) than at pod development stage (1.3 - 6.0) throughout the study period except during *Kharif,* 2002. Larval infestation per plant was more during

Table 1. Components imposed in IPM module

Component	*Kharif*, 2002	*Kharif*, 2003	*Kharif* ,2004	*Kharif*, 2005
Guard Crop	✓	✓	x	✓
Clipping of tips	✓	✓	✓	✓
Bird perches	✓	✓	✓	✓
Pheromone traps	✓	✓	✓	✓
Spraying of Azadirachtin	✓	✓	x	✓
NPV	✓	✓	x	✓
Mechanical shaking	✓	x	x	x
Need based spraying	x	x	x	x

✓ - Imposed x - Not Imposed

Table 2. Oviposition, larval incidence and per cent pod damage by *Helicoverpa armigera* in IPM

Treatment/Module	Mean number of eggs/plant							
	Kharif, 2002		*Kharif*, 2003		*Kharif*, 2004		*Kharif*, 2005	
	PF	PD	PF	PD	PF	PD	PF	PD
IPM (WRG-27)	-	-	3.18	1.55	5.8	3.8	8.3	1.3
IPM (ICPL- 87119)	1.44	1.64	-	-	7.13	3.8	8.3	1.5
Farmers' practice	-	-	9.80	2.30	8.7	4.2	10.5	3.9
Control	1.60	3.60	-	-	10.2	6.0	12.0	5.7

Treatment/Module	Mean number of larvae per plant							
	Kharif, 2002		*Kharif*, 2003		*Kharif*, 2004		*Kharif*, 2005	
	PF	PD	PF	PD	PF	PD	PF	PD
IPM (WRG-27)	-	-	0.08	1.93	0.7	0.6	0.1	2.6
IPM (ICPL- 87119)	0.64	1.0	-	-	2.3	0.6	0.5	3.3
Farmers' practice	-	-	1.15	8.75	1.0	1.4	0.7	3.5
Control	1.05	3.45	-	-	5.1	2.4	1.1	3.9

Treatment/Module	Per cent pod damage			
	Kharif, 2002	*Kharif*, 2003	*Kharif*, 2004	*Kharif*, 2005
IPM (WRG-27)	-	16.10	13.84	11.93
IPM (ICPL- 87119)	14.65	-	11.40	22.02
Farmers' practice	-	9.50	11.10	24.95
Control	30.60	-	24.15	34.32

PF = Peak flowering PD = Pod - development stage

Table 3. Grain yield (Q ha^{-1}) and benefit cost ratio (values in parentheses) of pigeonpea under IPM

Treatment/Module	*Kharif*, 2002	*Kharif*, 2003	*Kharif*, 2004	*Kharif*, 2005
IPM (WRG-27)	- (-)	16.10 (3.19)	7.35 (3.60)	7.10 (0.94)
IPM (ICPL- 87119)	15.60 (1.05)	- (-)	6.40 (2.08)	6.70 (0.51)
Farmers' practice	- (-)	9.50 (-)	6.23 (2.99)	5.98 (0.72)
Control	10.20 (-)	- (-)	4.50 (-)	5.29 (-)

pod development (0.6 - 8.75) than at flowering (0.08-5.1). Generally, *Helicoverpa* prefers to lay eggs on pigeonpea crop when it enters flowering stage. Egg laying was as high as 81.1% on floral parts whereas it was 18.9% on foliage (Venu Gopal Rao *et. al*., 1991). Several generations of *Helicoverpa* are found to occur between October and December in pigeonpea in Andhra Pradesh (Venu Gopal Rao *et.al.,* 1992.) In the initial stages of flowering, since oviposition just starts, eggs predominate in the redgram ecosystem. Later during the subsequent broods, both egg stage, all larval instars tend to be present. However, towards December at pod development stage egg laying has decreased when number of larvae are more than the number of eggs. This could be due to low temperatures and nonpalatability of seeds due to hardening. All these factors would have resulted in differences in oviposition and larval distribution across the stages. In *Kharif,* 04 larval number was considerably low during pod development stage. This was due to low pest load during that particular year.

IPM plots recorded lowest infestation level (both oviposition and larvae) than farmers' practice and control plot right from flowering to pod development stage. These differences resulted in variable per cent pod damage across the modules. The difference was sometimes marginal, especially when the general pest incidence was low in the particular season.

Pod damage was highest in unprotected control plot (24.15-34.32%). There was little difference in pod damage in IPM module imposed in susceptible variety ICPL 87119 (11.40-22.02%) and farmers' practice (9.5-24.95%). IPM components imposed in resistant variety (WRG 27) decreased the pod damage considerably (11.93-16.10%) than that in susceptible variety (ICPL 87119) (11.40-22.02%). This showed that selection of suitable (resistant) variety is important in deriving full benefits of IPM. Painter (1951) reported that host plant resistance can be used as a principal component of pest control in integrated management as an adjunct to other components.

Yield obtained in different plots indicated that highest yield was obtained in IPM plot of the variety WRG-27 followed by IPM plot of ICPL-87119, farmer's practice and unprotected plot with incremental benefit of Rs.0.94-3.6 for every rupee invested in IPM module in resistant variety Table 3. IPM module in susceptible variety gave IBCR of 0.51-2.08 as against IBCR of 0.72-2.99 in farmers' practice. Thus, it can be inferred that growing resistant variety is an important component of IPM. Little differences between IPM (susceptible variety) and farmers' practice revealed that in the absence of any chemical spray in IPM, spraying of biopesticides like NSKE, NPV coupled with mechanical and cultural methods like clipping of tips, mechanical shaking, etc. were found equivalent to one or 2 sprays of insecticides like endosulfan or quinalphos.

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