Efficacy of Different Insecticides for Pigeonpea Pest Management in Kenya

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The economically important insect pests of pigeonpea (*Cajanus cajan* (L.) Millsp.) in Kenya include the pod boring Lepidoptera (the most important are *Helicoverpa armigera* Hubner, *Maruca vitrata* (= *testulalis)* Geyer and *Etiella zinkenella* Treitschke, pod sucking bugs (dominated by *Clavigralla tomentosicollis* Stal and *C. horrida* Germar), and pod fly (*Melanagromyza chalcosoma* Spencer). Published information on pigeonpea insect pests as a constraint to production is limited in eastern Africa. In Tanzania, Materu (1970) reported that more than 50% of pigeonpea seeds were disfigured and unmarketable because of damage from pod sucking bugs. In Uganda, Kohler and Rachie (1971) recorded 5% seed damage by *H. armigera.* In Kenya, Okeyo-Owuor (1978) assessed losses in pigeonpea using data from pesticide trial and he attributed 13% seed loss to lepidopteran borers and 11% to pod fly. Surveys in farmers' fields in Kenya indicated that a number of farmers use pesticides for pest management on their traditionally grown land races (Minja et al. 1996). Among the insecticides commonly available to fanners in different locations in Kenya are: Permethrin (Ambush®), Deltamethrin (Decis®), Endosulfan (Thiodan®), Dimethoate (Rogor®), and Lambda-cyhalothrin (Karate®). However, there is little information on the type of chemicals that farmers should use on pigeonpea. To gather information on insecticide use on pigeonpea, trials were conducted at Kabete and Kiboko to evaluate the efficacy of some insecticides on short-, medium-, and long-duration pigeonpea genotypes.

At Kabete, six insecticides (Endosulfan [Thiodan® 35EC], Dimethoate [Rogor® E40], Pirimiphos-methyl [Actellic® 25EC], Tau-fluvalinate [Mavrik® 2E], *Bacillus thuringiensis* (Bt) [Thuricide® HP], and neem extract [Amrut Guard®]) were evaluated on the short-duration genotype ICPL 87091. At Kiboko, five insecticides (Endosulfan, Dimethoate, Pirimiphos-methyl, *B. thuringiensis* (Bt), and Deltamethrin [Decis ULV]) were evaluated on three pigeonpea genotypes (the short-duration ICPL 87091, medium-duration ICP 6927, and long-duration ICEAP 00020).

Pigeonpea was planted in the second week of November 1995 at Kiboko and Kabete in 20 m x 10 m plots, replicated thrice in randomized complete blocks. Four sprays of each insecticide were applied in each plot at 10-15 day interval starting at flower initiation. Endosulfan was applied at a rate of 1.0 kg active ingredient per hectare (a.i.ha^{-1}), Dimethoate at 0.5 kg a.i.ha^{-1}, Pirimiphos-methyl at 0.05 kg a.i.ha^{-1}, Tau-fluvalinate at 0.05 kg a.i.ha^{-1}, *B. thuringiensis* (Bt) at 0.4 kg a.i.ha^{-1}, and neem extract at 0.5 kg a.i.ha^{-1}. High volume spraying, i.e., 200 liters of water ha^{-1} was used throughout. Endosulfan and dimethoate were directly purchased from commercial stores, while pirimiphos-methyl, Bt, Deltamethrin, and neem were supplied by chemical company marketing offices.

Damage assessment was carried out at pod maturity (when most pods were mature but not dry). Pods from five randomly selected plants plot^{-1} were destructively sampled. Each pod was later examined for pod and seed damage and the insect pest that caused the damage. The number of seeds damaged by each pest group was expressed as a proportion of the total number of seeds plot^{-1} Grain yields were determined from each plot at harvest. Yield gains were calculated based on the differences between sprayed and unsprayed yields expressed as proportions of the unsprayed plot yields. Thus,

$$\text{Yield gain} = \frac{\text{Sprayed-Unsprayed}}{\text{Unsprayed}} \times 100$$

All data was subjected to analysis of variance using Genstat 5.

The major insect pests on pigeonpea were pod borers *(H. armigera, M. vitrata, E. zinkenella,* and *Lampides boeticus* L. at Kiboko; *H. armigera, E. zinkenella,* and *L. boeticus* at Kabete), pod sucking bugs (*C. tomentosicollis),* and pod fly *(M. chalcosoma)* at both locations. The results indicated that all sprays improved grain yields and seed quality at Kabete, with 57-152% grain yield gains in different insecticide treatments. Endosulfan appeared to perform better among the high volume sprayed insecticides at Kabete. Pod fly damage was less in plots treated with dimethoate than endosulfan (Table 1). Dimethoate has a depth action on plant surfaces which might have contributed to its effectiveness on pod fly larvae feeding inside the pods and egg laying adults.

Table 1. Seed damage (%) due to insect pests and grain yields of ICPL 87091 sprayed with different insecticides at Kabete, Kenya during 1995/96.

	Seed damage (%)				Grain yield and seed quality			
Treatment	Pod borers	Sucking bugs	Pod fly	Total	Yield (t ha^{-1})	Yield gain (%)	Damaged grain (%)	100-seed mass (g)
Endosulfan	6.1	6.6	2.8	15.5	2.50	152.5	1.0	14.3
Dimethoate	10.0	7.9	0.4	18.3	2.36	138.4	2.4	14.5
Pirimiphos-methyl	8.1	5.1	0.6	13.8	2.43	145.4	2.9	14.3
Tau-fluvalinate	11.5	9.6	0.8	21.9	2.20	122.2	1.0	14.8
B. thuringiensis	11.2	7.4	1.0	19.6	1.60	61.6	3.6	15.0
Neem extract	10.1	8.4	3.0	21.5	1.56	57.6	5.8	14.9
Untreated control	25.0	14.2	3.2	42.4	0.99	0	5.4	7.3
Mean	11.7	8.5	1.7	21.6	1.95	-	3.1	13.6
SE	±1.83	±1.15	±0.66	±1.18	±0.23	-	±0.65	±0.62
CV (%)	33.2	34.7	58.2	24.2	20.4	-	35.7	4.5

Table 2. Seed damage (%) due to insect pests on three pigeonpea genotypes sprayed with different insecticides at Kiboko, Kenya during 1995/96.

	Seed damage (%)										
	ICPL 87091[1]			ICP 6927				ICEAP 00020			
Treatment	Pod borers	Sucking bugs	Total	Pod borers	Sucking bugs	Pod fly	Total	Pod borers	Sucking bugs	Pod fly	Total
Endosulfan	0.2	0.8	1.0	1.7	3.0	0.3	5.0	0.3	3.8	2.8	6.9
Dimethoate	3.7	0.7	4.4	3.1	2.1	0.1	5.3	0.7	3.0	0.2	3.9
Pirimiphos-methyl	3.8	1.1	4.9	3.9	6.1	0.2	10.2	1.3	4.3	1.6	7.2
B. thuringiensis	9.8	1.1	11.0	3.0	3.6	0.4	7.0	1.5	9.9	2.4	13.8
Deltamethrin (ULV)	0.0	1.4	1.4	0.3	3.6	0.1	4.0	0.8	1.7	0.7	3.2
Mean	3.5	1.0	4.5	3.5	3.7	0.2	6.3	0.9	4.5	1.5	7.0
SE	±0.81	±0.56	±0.52	±0.81	±0.56	±0.12	±0.52	±0.81	±0.56	±0.12	±0.52
CV(%)	39.3	20.7	22.4	39.3	20.7	41.5	22.4	39.3	20.7	41.5	22.4

1. Pod fly incidence was negligible on ICPL 87091.

The results from Kiboko showed that the use of ultra-low-volume (ULV) spraying was most efficient in the management of the pests compared to the high volume sprayed insecticides. Endosulfan was also good among the high volume sprays (Table 2). Spraying the short-duration genotype with ULV resulted in lower pest population compared to the medium- and long-duration genotypes. The ULV spraying on the uniformly short crop ensured a better droplet cover than on the tall and spreading branches of the medium- and long-duration genotypes. ULV spraying may be of interest in the semi-arid pigeonpea growing areas where water is a limiting factor to high volume spraying. However, the cost/benefit and safety of using ULV have to be discussed carefully.

The results from Kiboko also showed that the incidence and damage due to pod sucking bugs and pod fly increased during the crop maturity phase. The populations of pod sucking bugs and pod fly increased gradually in the medium- to long-duration genotypes. Pod fly incidence on the short-duration pigeonpea genotype at Kiboko was negligible during the short rainy season. Pod borer incidence and damage, on the other hand, decreased during crop maturity phase. These insect pest population changes correlate to gradual decrease in temperature at Kiboko.

The seed losses reported by Okeyo-Owuor (1978) are much higher than in the present studies but they correlate well with results from farmers' field surveys in Kenya

(Minja et al. 1996). It was further observed in farmers' fields and at research stations that insect pest populations on pigeonpea vary greatly between locations and between seasons at the same location. Different pigeonpea genotypes were also used at Kabete and Kiboko where crop management was different from that on farmers' fields.

The results on insecticides indicated that neem extract and *B. thuringiensis* were not as effective as the synthetic insecticides in reducing pest numbers and pigeonpea seed losses at Kabete and Kiboko. Neem extract and *B. thuringiensis* are among the commonly used biopesticides. They act slowly and have to be ingested, and are, therefore, suitable for some of the pod borers (e.g. *H. armigera),* where treatments should start very early in the season. If farmers adopt biopesticides, they have to be prepared for higher crop losses than when they would use conventional chemical pesticides. The advantage of biopesticides is that they are safer than chemical pesticides. Substantial numbers of general predatory arthropods were observed at Kabete and Kiboko during the vegetative and reproductive stages of the crop. These arthropods are easily killed by some of the non-selective insecticides. Among the conventional insecticides, endosulfan is known to be selective against some of the natural enemies of insect pests (Wiktelius et al. 1999).

Judicious use of these pesticides has to be adopted to safeguard the environment and health of farmers and consumers (Holt et al. 1990). This is important because there are reports of H. *armigera* resistance to pyrethroids and endosulfan in India (Lateef 1991). It is advisable to alternate chemical pesticides at least between seasons but more reasonably between two or three sprays within a season to minimize the tendency of pests developing resistance to a particular chemical. It is of practical importance to scout fields to assess pest incidences. This will assist in making decisions that will minimize environmental contamination through unnecessary use of pesticides. Thus there is need for thorough training of farmers before they embark on wide use of pesticides on pigeonpea in the region.

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