The survey technique involved selection of fields at random depending on visibility and accessibility to the road. At each site, 50–150 pigeonpea pod samples were collected from individual fields. Sample sizes varied because of farm size, plant population, and farmer cooperation. The collected pods were later opened, and seed damage because of the various pests calculated.

The complex of insect pests on pigeonpea in Kenya, Malawi, Tanzania, and Uganda appeared to be similar for the major pest groups (pod borers, pod-sucking bugs, and podflies). Among the borers, however, *M. testulalis* was not recorded in Malawi, and yet it was one of the major borers on flower buds, flowers and pods in the coastal provinces of Kenya and Tanzania, and in northern Uganda. The incidence, distribution, and damage levels of specific pests varied among countries. In Kenya there were also variations because of crop maturity (Table 1). Early-season damage in Jul was mainly because of pod borers and pod-sucking bugs, and the total seed damage was 13%. Most seed damage during mid-season in Aug was because of podflies and to a lesser extent to pod borers and pod-sucking bugs. Total seed damage in Aug was 27%. Seed damage because of insect pests in the other countries was 16% in Malawi, 14% in Uganda, and 13% in Tanzania. The insects which caused the greatest seed damage varied among countries: podfly was more damaging in Kenya, pod-sucking bugs in Malawi, and pod borers in both Tanzania and Uganda. These surveys, which provide a 'snapshot' of insect damage and seed losses, highlight the importance of this constraint to pigeonpea production. More detailed studies in each country are needed to assess yield losses, and pest population dynamics in order to develop effective pest-management strategies. A more comprehensive account of these surveys is currently being prepared for publication.

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Pigeonpea Farmers in Southern and Eastern Africa: Do They Spray Their Crop?

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Pigeonpea is an important crop in several African countries, where it is both a cash crop grown for export and a

Table 1. Pesticide use and pigeonpea seed damage in farmers' field crop in Kenya, Jul and Aug 1995.

Farmer practice	No. of farmers	Seed damage (%)		No. of farmers	Seed damage (%)	
		Range	Mean ± SD		Range	Mean ± SD
No spray	11	5.8–17.9	13.0 ± 3.7	15	12.3–52.6	23.3 ± 12.8
One spray	3	8.7–16.9	13.2 ± 4.2	4	11.5–51.9	26.6 ± 15.2
Two sprays	3	5.9–16.4	10.7 ± 5.3	7	7.2–48.1	21.9 ± 15.3
Three or more sprays	-	-	-	6	25.8–63.0	42.9 ± 13.7

subsistence crop consumed as green and dry peas (Singh 1991). It is widely believed that farmers in Africa do not use chemical pesticides on their crop. Although insect pests cause major losses to the crop in Africa, pigeonpea is generally grown with little pesticide protection in farmers' fields relative to pesticide use in other regions (Lateef 1991). Since there is little or no information available about farmers' pest management practices in southern and eastern Africa, a series of surveys were conducted in farmers' fields, to collect information about farmers' perception of insect pests on their crop, and the management practices which they commonly use.

The survey technique involved the selection of fields at random depending on their accessibility from the road. Different agroecological zones were surveyed in each country. Pigeonpea pod samples were collected from each field. The pods were used for seed damage assessment. All farmers surveyed were interviewed about their perception of insect pests, crop damage levels, and their pest-management practices. Records on pests, natural enemies, and cropping practices were made.

In Malawi, Tanzania, and Uganda, farmers indicated that they did not use any chemical pesticide for insect pest management on pigeonpea in the field. Some of these farmers, however, indicated that they often use pirimiphos-methyl (Actellic Super®) powder to dust their grain before storage. Most farmers use chillies, wood ash, and various other herbs to protect stored grain and seed material.

In Kenya on the other hand, the surveys showed that farmers use commercial chemical pesticide sprays on their landrace long-duration pigeonpea crop (35.3% of farmers surveyed in Jul and 53.1% of farmers surveyed in Aug 1995 indicated that they used pesticides). Pesticide use was particularly widespread in the cash crop growing areas of Embu, Kirinyaga, Meru, and Tharaka Nthi. The pesticides, which were almost always used inappropriately, were those used on cash crops such as coffee, cotton, vegetables, and rice.

The high level of pesticide use in the cash crop growing areas is due to availability of chemicals through the cooperatives. Once any pesticide was available on credit from the cooperatives for use on cash crops, it was also used on the other crops including pigeonpea. High frequencies of pesticide application (more than 18% of farmers sprayed three or more times per season) was also associated with availability but because farmers used the wrong chemical, wrong doses/concentration, and at the wrong time, seed damage levels were as high or higher in frequently sprayed fields compared to nonsprayed fields, reflecting ineffective control (Table 1). Some farmers in Kirinyaga had used fungicides recommended for use on tomatoes to control insect pests on pigeonpea. This indicates lack of knowledge in differentiating between insecticides and fungicides. Farmers in lower Meru had timed their pesticide applications wrongly by spraying the crop before or after major pest infestations. Some farmers in this area had sprayed once with a synthetic pyrethroid, Ambush® (permethrin) at flowering while others used the same insecticide once after podding. Farmers in Embu had sprayed Ambush® on cotton which flowered earlier than the long-duration pigeonpea, and they expected the same insecticide sprays to kill insect pests on pigeonpea a month later. Such a situation indicates lack of knowledge on the persistence of specific pesticides, and the incidence of pests on different crops in relation to their phenology. All surveyed farmers were spraying their pigeonpea crop using pesticide doses and spraying frequencies recommended for their priority cash crops. They claimed to have had no formal advice on pigeonpea production technologies.

In areas where farmers did not use any conventional pesticides on their pigeonpea crop, some of them indicated that there was limited availability of the pesticides, which were also highly priced, lack of spraying equipment, lack of water, and lack of skill in using pesticides and sprayers effectively. The pest management problems revealed by the surveys, show the need to train farmers in Kenya where pesticides are already in use. It also highlights the importance of scouting for pests, and proper timing of insecticide applications to safeguard the health of the farmers and the environment. Furthermore, there is need to screen pesticides and spraying equipment that are available in each country to identify the most effective and safest means of pesticide use on pigeonpea. The extension service in each country has to be involved in the training to enable them address the inappropriate application of the pesticides, and the timing of the sprays.

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Antibiotic Effect of Pigeonpea Wild Relatives on *Helicoverpa armigera*

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Antibiosis, one of three types of resistance mechanisms proposed by Painter (1951), is described as those adverse effects on the insect life history when a resistant host-plant variety is used as food. The adverse effect on the insect can be in the form of reduced fecundity, decreased size, abnormal length of life and/or increased mortality (Owens 1975). We investigated the antibiotic effects of flowers of some wild relatives of pigeonpea *Cajanus scarabaeoides*, *C. cajanifolius*, *C. reticulatus*, *C. sericus*, F_1 (*C. scarabaeoides* × *C. cajan*), and cultivated pigeonpea (T 15-15) on the biology of the pod borer, *Helicoverpa armigera*. The experiment was conducted during Dec 1993–Feb 1994 at Entomology Research Laboratory, Pulses Research Station, Gujarat Agricultural University, Sardar Krushinagar, India.

Freshly emerged male and female moths from field collected larvae were confined in a rearing cage (60 × 60 × 60 cm). Healthy fresh twigs with flowers were provided for oviposition and 5% honey solution was provided as food. Neonate larvae obtained from the eggs were transferred with a hairbrush to specimen tubes (8 × 4 cm) with flowers of different wild species and pigeonpea. Ini-

Table 1. Growth and development of *Helicoverpa armigera* on different *Cajanus* species, Sardar Krushinagar, India, 1993–94.

Treatments (hosts)	Larval weight (mg)	Larval period (days)	Pupal weight (mg)	Pupal length (cm)	Pupal period (days)	Larval mortality[1] (%)	Larvae pupated (%)	Adult emergence	Growth index[2]
Cajanus scarabaeoides	57	41.60	161	1.72	16.60	80.00	20.00	20.00	0.48
C. cajanifolius	145	35.49	154	1.66	19.75	44.00	48.00	32.00	1.36
C. reticulatus	85	35.75	128	1.41	19.00	48.00	52.00	32.00	1.45
C. sericeus	61	43.86	176	1.64	15.14	68.00	32.00	28.00	0.73
Rhinchosia rothii	143	35.23	174	1.70	19.70	52.00	44.00	40.00	1.25
F_1 (*C. scarabaeoides* × *C. cajan*)	102	38.92	165	1.64	17.00	32.00	60.00	44.00	1.54
C. cajan	212	30.22	293	2.02	15.80	23.77	76.92	60.00	2.55
GM.	120	36.84	171	1.68	17.80	49.68	47.56	36.57	
SE	±18	±1.16	±14	±0.36	±00.57				
CD at 5%	50	3.31	40	0.102	1.61				
CV (%)	45.64	9.02	24.19	6.61	8.52				

1. Larval mortality (%) 7 days after hatching.
2. Growth Index = (Percentage larvae pupated)/Larval period (days) × 100.