under the agroclimatic conditions of the south coastal belt of Orissa.

Three varieties, UPAS 120 (early), C 11 (medium), and PUSA 9 (late) were sown in strips of 20 m^2 under rainfed conditions in sandy loam soil (pH 6.9) during 1994 and 1995 at the Central Agriculture Research Station, Orissa University of Agriculture and Technology, Bhubaneswar, Orissa. The extent of raceme damage (%) by the pod borers was recorded at 50% flowering and pod-filling stages by counting the total number of buds/flowers and number of buds/flowers webbed on 12 plant samples.

The pigeonpea racemes comprising leaves, buds, flowers, and pods were infested by *Maruca vitrata* Geyer, *Nanaguna breviuscula* Walker, and *Grapholita critica* Meyr. resulting in dropping of buds and flowers (Samalo and Patnaik 1984, Sekhar et al. 1991, Bajpai et al. 1995). At the 50% flowering stage, *M. vitrata* was the dominant species, which damaged 6.41, 4.17, and 0.90% racemes in early (UPAS 120), medium (C 11), and late (PUSA 9) varieties respectively (Table 1). *Nanaguna breviuscula* and *G. critica* infested 1.28–3.99% and 1.20–3.95% racemes respectively in different varieties. At the pod-filling stage in 1994/95 and 1995/96, *N. breviuscula* infested 4.30–18.13% and 8.50–30.31% of the racemes as against 2.50–10.66% and 6.31–18.52% by *M. vitrata*, and 3.30–5.84% and 2.10–8.50% by *G. critica* respectively.

The early-maturing variety was more prone to damage by the pod borers (45.98%) in comparison to medium- (32.59%) and late-maturing (10.31%) varieties at both the stages. *Maruca vitrata* at 50% flowering in early variety and *N. breviuscula* at pod-filling stage in the medium-maturing vareity were the dominant species. On the contrary in late-maturing variety, *N. breviuscula* was the major web-forming species in both the flowering and the pod-filling stages.

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Insect Pests of Pigeonpea in South Africa: Survey Report

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Pigeonpea (*Cajanus cajan*) is not widely cultivated in South Africa. But there is great demand for its dry, split seeds called "oil-dhal" by the local Asian community. Preliminary investigations by the authors (C Mathews and K B Saxena) on the marketing and utilization of this crop showed that about 120–150 tonnes of “oil-dhal” is imported from Malawi each month to meet the needs of over a million Indians living in South Africa. The total value of the imports is around US$ 1 million annually. The entire pigeonpea crop produced around house gardens locally is utilized as green vegetable by the Asian community and the whole dry seeds for making soup by the local African community.

From time to time, a few agricultural organizations in South Africa have undertaken research activities on specific aspects such as germplasm collection and description, use as forage crop, and local adaptability. A total of 672 pigeonpea germplasm accessions have been collected and preserved by the South African Gene Bank in Pretoria (van den Heever and Trytsman 2000). Pigeonpea is basically a low input, subsistence crop; as a result, the national research institutes did very little to popularize it among the South African farmers. During the late 1980s, efforts to introduce pigeonpea into the local smallholder farming systems were initiated by Brian Beck of the Provincial Research Unit in Mpumalanga using the short-duration cultivar Hunt. The farmers, however, rejected it because of the long cooking time required for its preparation. In 1992, eight improved genotypes from ICRISAT were tested in a farmer’s plot, 100 km east of Nelspruit. Unfortunately, the entire crop was destroyed by cattle. Pigeonpea research received attention again in 1998, with the aim of providing a multiple usage crop to the smallholder, resource-poor, dryland farmers in Mpumalanga. Formal trials to evaluate performance of 9 short-duration, 5 medium-duration, and 3 long-duration ICRISAT genotypes commenced in 1998.

Over 200 species of insects feeding on pigeonpeas have been recorded in India alone (Lateef and Reed 1990). Most of these, especially the foliar feeding insects do not cause serious economic damage, and are considered as minor pests. Studies in India have shown that the removal of up to 75% of pigeonpea leaves for extensive periods did not result in significant yield losses, and that most of the pigeonpea genotypes produce abundant buds and flowers and a large proportion of these will normally be shed (Sheldrake et al. 1979). Thus, pigeonpea plants are able to give satisfactory yields even after a large proportion of their buds and flowers have been damaged by insect pests. These plants, especially the indeterminate types, produce new growth with the potential to compensate for the previous losses under favorable climatic conditions.

The insects that attack the pods are considered the most important pests of pigeonpea. Pod borers (including *Helicoverpa armigera* and *Maruca vitrata*) and pod-sucking bugs (mainly *Clavigralla* spp) are the major pests in these groups. The pod borer *H. armigera* is the most important constraint to pigeonpea production throughout South Asia (Ranga Rao and Shanower 1999). The larvae of this insect destroy buds, flowers, and pods. They attack leaves in the absence of the floral organs. *Maruca* larva feeds from inside a webbed mass of leaves and it becomes a menace early in the season especially in areas with high humidity. The adults and nymphs of the pod-sucking bugs (*Clavigralla* spp and *Nezara viridula*) pierce the pod wall and suck the fluid from the developing seeds. The attacked seeds shrivel and develop dark patches. These pests are very common in Africa and Asia, particularly in dry seasons (Reed and Lateef 1990). Aphids colonize the young shoots, flowers, and pods. The young leaves of seedlings become twisted under heavy infestation and wilt when the plant is under moisture stress. The scale insects such as *Icerya purchasi* suck fluids in the stems and occasionally in the leaves. Thrips and blister beetles normally attack the flowers and heavy infestation may lead to flower drop. Infestation by bruchids (*Callosobruchus* spp) starts in the field. The infested seeds lose their viability and are unfit for human consumption. Delayed harvesting, poor drying, and storage facilities can lead to total loss of pigeonpea grain due to this pest.

In May 2000, a team of scientists visited trial sites and farmers' fields to monitor the pigeonpea crop, especially with respect to the biotic and abiotic stress problems, which should be addressed in future work. The observations made on the incidence of insect pests of pigeonpea for the first time in South Africa are summarized in this short note.

The pigeonpea trials and farmers' plots located at White River, Nelspruit, Malekutu, Phola, and Mzinti in Mpumalanga Province; at Cedara in Pietermaritzburg and Mariannhill near Durban in the Kwazulu-Natal Province; and at the Agricultural Research Council (ARC), Roodeplaat near Pretoria were visited.

In a non-governmental organization (NGO) project at Mariannhill, the long-duration pigeonpea landraces were included in the cropping system for the first time in 1999. The presence of the pod borer (*H. armigera*) and aphids were observed on pigeonpea at this site. At Cedara, the 2- to 3-year-old long-duration landraces were established as hedgerow and they were free of insect pests. At Roodeplaat, pigeonpea cultivars were maintained as part of germplasm preservation. The plants appeared to be at least 2–3 years old and were free of insect pests during the visit.

The major insect pests present in the trial plots in Mpumalanga during 1998/99 season were the pod borer (*H. armigera*) and pod-sucking bugs (*Clavigralla* spp). Three sprays with cyhalothrin (Karate®) on the short-duration genotypes, and once on the medium- and long-duration genotypes effectively controlled these insects. These two pests were observed at all sites in Mpumalanga.

Observations during 1999/2000 season showed that the species of insect pests and the severity of damage on pigeonpea have increased considerably from the previous season. The damage caused by insect pests on flowers and pods were more severe on the short-duration types than the long- and medium-duration types. All the insects listed below except the scale insect were present on the short-duration types during the 1999/2000 season. The incidence of insect pests was comparatively low on the medium- and long-duration genotypes and a satisfactory crop was obtained from these without the use of any chemical sprays. The differences in pest incidence between the pigeonpea maturity groups may be due to the cooler, winter environment that prevails during the flowering and podding stages of these genotypes compared to the short-duration group. Insect pests are most active in warm and humid environments. Similar observations have been made on pigeonpea in other parts of southern and eastern Africa (Minja et al. 1999).

The major insects observed on pigeonpea in South Africa were: *Clavigralla* spp, *H. armigera*, and bruchids (*Callosobruchus* spp). These pests were present in large populations and they caused serious yield losses locally although the losses have not been quantified. *Maruca* was only found in the short-duration genotypes at Malekutu. Minor pests included *N. viridula*, *M. vitrata*, *Aphis* spp, jassids (*Empoasca kerri*), scale insect (*I. purchasi*),

thrips (*Megalurothrips usitatus*), and blister beetles (*Mylabris* spp), which apart from the green aphids, were only restricted to certain localities in Mpumalanga.

These preliminary results indicate:

- Studies to estimate the potential yield losses caused by these insect pests in different pigeonpea genotypes should be undertaken.
- Chemical control is considered as the most efficient method employed to control these insect pests. However, the resource-poor farmers who are being targeted to adopt this crop in South Africa will find chemical control a difficult option.
- There is therefore, a great need to develop affordable integrated pest management strategies involving cultural, genetic, and biological approaches for the successful promotion of this crop in South Africa.

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Agronomy

Evaluation of Pigeonpea Genotypes for Rainfed Conditions in the Southern Zone of Andhra Pradesh, India

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Pigeonpea (*Cajanus cajan*) is an important pulse crop grown in the rainy season in Andhra Pradesh, India. It is grown in an area of 0.35 million ha in Andhra Pradesh. In the Southern Zone of Andhra Pradesh, pigeonpea is grown as an intercrop with rainfed groundnut (*Arachis hypogaea*) in different ratios, i.e., 1:11, 1:15, and 1:23. Whenever the Southwest monsoon is delayed or fails, pigeonpea is found to be the most remunerative contingent crop and can be grown as sole crop with a spacing of 60 × 20 cm during August in red soils of this zone by taking advantage of the Northeast monsoon which contributes about 45–50% of total rainfal of this zone (ANGRAU 1995). The average rainfall over the past ten years is 1075.6 mm. The high yield potential of pigeonpea crop (around 2.0 t ha^{-1}) has not reflected in increased productivity of this crop in farmers' fields. This might be due to cultivation of traditional varieties and also

Table 1. Performance of pigeonpea genotypes during rainy season in 1996–98 at Tirupati, Andhra Pradesh, India.

	Seed yield (t ha^{-1})			
Genotype	1996	1997	1998	Mean
LRG 30	1.7	1.1	1.8	1.5
ICPL 332	1.3	0.9	1.7	1.3
ICPL 87119	1.2	0.9	1.0	1.0
ICP 8863	0.8	1.0	1.3	1.0
MRG 66	1.4	0.7	1.2	1.1
ICPL 85063	1.1	0.8	1.2	1.0
Selection No. 17	1.3	0.9	1.2	1.1
Selection No. 27	1.3	0.9	1.1	1.1
ICPL 87051	0.7	0.8	1.0	0.8
Local variety	0.7	0.8	0.9	0.8
Mean	1.1	0.9	1.3	–
SEm ±	0.071	0.083	1.76	
CV (%)	0.07	0.14	0.13	