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Pigeon pea diseases in Malawi

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Summary. In a survey of pigeon pea in northern, central and southern Malawi in 1991, fusarium wilt, cercospora leaf spot, powdery mildew, bacterial canker (not confirmed), macrophomina stem canker and root-knot were observed, with fusarium wilt being the most severe and destructive diseases. Average wilt incidence was 6.3 percent, but it was as high as 50 percent in some areas. The reduced incidence of wilt observed compared with that found in a 1980 survey (36.3 percent) may be the result of the introduction of the wilt-resistant cultivar ICP 9145. Expanding the area under ICP 9145, incorporating wilt resistance in local landraces and increasing plant population levels should help to increase pigeon pea production. The local landraces cultivated appear to be tolerant to powdery mildew, cercospora leaf spot, macrophomina stem canker and root-knot. These diseases must be considered when developing new cultivars.

MALADIES DU POIS CAJAN AU MALAWI

Résumé. En 1991, une enquête a été effectuée sur les maladies du pois cajan dans le nord, le centre et le sud du Malawi. Les maladies observées ont été le flétrissement, la cercosporiose, le mal blanc, le flétrissement bactérien (non confirmé), la pourriture des racines (causée par *macrophomina*) et l'anguillule des racines, la maladie la plus grave et la plus destructrice étant le flétrissement. L'incidence moyenne de ce dernier dans le pays est de 6,3 pour cent et peut aller jusqu'à 50 pour cent selon les endroits. Cette moindre incidence du flétrissement comparée aux résultats de l'enquête de 1980 (36,3 pour cent) est peut-être due à l'introduction du cultivar ICP 9145 résistant à la maladie. Si l'on augmente la superficie plantée en ICP 9145, que l'on incorpore un gène résistant au flétrissement dans les races de terrain locales et que l'on intensifie les cultures, cela devrait permettre d'accroître la production de pois cajan. Les races de terrain locales actuellement cultivées semblent manifester une tolérance pour le mal blanc, la cercosporiose, la pourriture des racines et l'anguillule. Ces maladies devront être examinées lors de la mise au point de nouveaux cultivars.

ENFERMEDADES DEL GUANDU EN MALAWI

Resumen. En 1991 se llevó a cabo una encuesta para estudiar los problemas de las enfermedades del guandú en las regiones septentrional, central y meridional de Malawi. Se observó la presencia de fusariosis, cercosporiosis, oídio, cáncer bacteriano (no confirmado), cáncer del tallo causado por *Macrophomina* y tumor bacteriano, siendo la fusariosis la enfermedad más grave y destructiva, con una incidencia media del 6,3 por ciento que llegaba incluso al 50 por ciento en algunas zonas. La menor incidencia de la fusariosis observada en la presente encuesta, en comparación con la que se había encontrado en la de 1980 (36,3 por ciento), puede deberse a la introducción del cultivar ICP 9145, más resistente a la enfermedad.

El aumento del cultivar ICP 9145, la incorporación a variedades locales de resistencia a la fusariosis y el aumento del nivel de población de plantas deberían contribuir a aumentar la población de guandú. Parece que las variedades locales cultivadas son tolerantes al oídio, la cercosporiosis, el cáncer de los tallos causado por *Macrophomina* y el tumor bacteriano. Es preciso examinar estas enfermedades a la hora de obtener nuevos cultivares.

Pigeon pea, *Cajanus cajan* (L.) Millsp., is an important food legume in Malawi (Nyasulu, 1990), and it is also becoming a cash crop for smallholder farmers. Pigeon pea currently ranks third to groundnut and *Phaseolus* beans in legume production in Malawi, however, the area and production of pigeon pea have been fluctuating in recent years (Tables 1 and 2) (Soko, 1990). Wilt disease caused by *Fusarium udum* Butler (*F. oxysporum* f. sp.

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TABLE 1. **Estimated production of food legumes in Malawi during the 1988/89 crop season**

Crop	Production (*t*)
Groundnut	34 752
Phaseolus bean	27 447
Pigeon pea	12 075
Cowpea	6 241
Gram	3 106
Chickpea	1 451
Guar bean	1 100

Source: Soko, 1990.

udum) is considered to be the major cause of declines in pigeon pea production in Malawi.

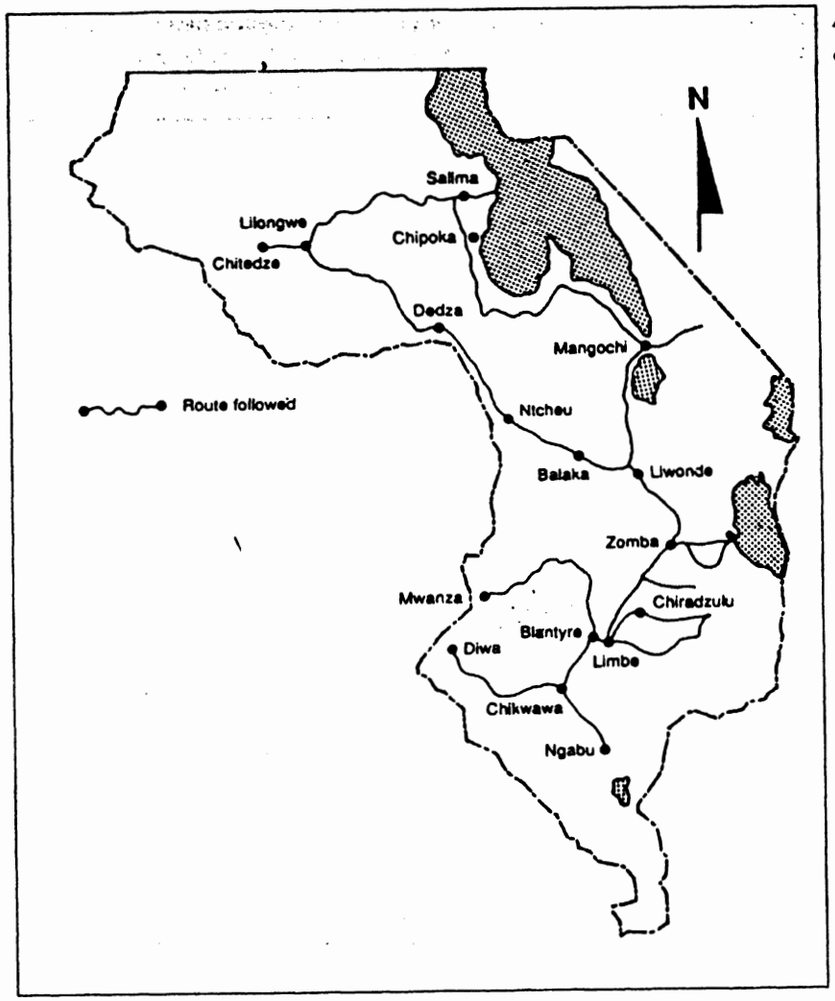
At present pigeon pea is cultivated mainly as a mixed crop with maize, sorghum and cassava. Late-maturing landraces (10 months' duration) that are mixtures with longer pods and larger seeds (about 15 g for every 100 seeds) are grown. Improvement of pigeon pea in Malawi has been undertaken only since 1980, with the collection of local germplasm and the introduction of plant material from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru, India, and other sources. The increased emphasis placed on pigeon pea production by the Malawian Government and the implementation of FAO and ICRISAT pigeon pea projects are providing much needed impetus to pigeon pea research in Malawi.

Identification of the constraints to pigeon pea production is essential to the formulation of strategies for its improvement. An earlier survey of pigeon pea diseases, carried out during 1980, revealed wilt incidence of 36.3 percent in the country (Kannaiyan *et al.*, 1984). ICP 9145, a cultivar resistant to fusarium wilt and selected from the ICRISAT-operated International Pigeonpea Wilt Nursery (Reddy *et al.*, 1990), was released for general cultivation in 1987 (Soko, 1990). The present survey was undertaken jointly by ICRISAT, the FAO pigeon pea project and the University of Malawi to study the performance of this cultivar in farmers' fields and to assess the disease situation in major pigeon pea-producing areas of the country. This visit was also used to collect pigeon pea wilt samples for a *F. udum* race study in Malawi. Major production areas in northern, central and southern Malawi were visited (see Map) and meetings were held with the crop husbandry officers of the respective agricultural development divisions (ADDs). The information collected during the survey included location and size of the field, cropping patterns (i.e. sole, inter- or mixed cropping), percentage of area under pigeon pea, stage of crop growth, different diseases based on observations made on 500 plants, soil type and other information including crop rotation and previous disease history. Stops and observations were made about

TABLE 2. **Estimated pigeon pea production by smallholder farmers in agricultural development divisions in Malawi from 1985/86 to 1988/89**

Agricultural development division	1985/86		1986/87		1987/88		1988/89	
	ha	*t*	*ha*	*t*	*ha*	*t*	*ha*	*t*
Mzuzu	-	-	224	134	137	82	112	66
Lilongwe	-	-	700	360	350	245	470	287
Salima	464	359	722	535	617	340	774	499
Liwonde	6 600	2 835	3 053	7 040	13 711	5 744	5 802	2 769
Blantyre	11 280	4 520	20 165	8 570	16 886	8 141	16 045	6 260
Ngabu	1 470	882	5 800	2 594	3 085	1 970	3 339	2 194
Total	**19 904**	**8 596**	**30 664**	**19 233**	**34 786**	**16 522**	**26 542**	**12 075**

Source: Soko, 1990.



Areas surveyed for pigeon pea diseases in Malawi

every 10 to 15 km. The incidence of diseases such as wilt, macrophomina stem canker and bacterial stem canker was recorded. For foliar diseases such as cercospora leaf spot and powdery mildew, the severity of the disease was also recorded.

SURVEY FINDINGS

The crop at the time of the visit was in the maturing to harvesting stage. Fields of both local cultivars and the recently released wilt-resistant cultivar ICP 9145 were visited. ICP 9145 was found to be earlier maturing than the local cultivars. The local cultivars were invariably mixtures comprising plants of different growth habits, maturity, pod length, pod colour and seed colour. They were mostly grown as a mixed crop and mainly with maize, except in a few fields near the Shire River in the Mwanza district of Blantyre ADD where large fields (more than 10 ha) of only pigeon pea were seen. Other crops mixed with pigeon pea were sorghum, cassava, tomato, bean and groundnut. Pigeon pea was mainly grown as an annual. In one field near the Shire River in the district of Mwanza, perennial pigeon pea was seen in newly cleared forest land. The size of the pigeon pea fields surveyed ranged from 0.1 to 10 ha. The soil types in which the crop was cultivated were red sandy, sandy loam, black loam, black clay, brown loamy and brown sandy. The most striking feature of pigeon pea cultivation in Malawi was the variable plant population in different fields. The area under pigeon pea in various fields ranged from 10 to 100 percent. Some of the local cultivars in the Zomba district of Blantyre ADD (Masambuka Village) appeared to be highly

productive compared with ICP 9145. Collection of such landraces should receive high priority.

The diseases observed during the survey include fusarium wilt (*Fusarium udum*), powdery mildew [*Laveillula taurica* (Lev.) Arnaud], cercospora leaf spot [*Mycovellosiella cajani* (Henn.) Rangel ex. Trotter], bacterial stem canker [*Xanthomonas campestris* pv. *cajani* (Kulkarni *et al.*) Dye *et al.*] (not confirmed), macrophomina stem canker [(*Macrophomina phaseolina* (Tassi) Goid.] and root-knot (*Meloidogyne* spp.). Fusarium wilt was the most severe and destructive disease of pigeon pea, as well as the most widespread. The average incidence in Malawi was 6.3 percent (Table 3), and in some fields it was as much as 50 percent. Wilt incidence was high in the Karonga, Rumphi, Nkata Bay, Liwonde and Blantyre ADDs, but it was not observed at all in the Lilongwe and Ngabu ADDs. The incidence of wilt observed in the present survey was less than that found in Malawi in the 1980 survey (36.3 percent) by Kannaiyan *et al.* (1984), perhaps because of the introduction of the wilt-resistant cultivar ICP 9145. Wilt was not observed in this cultivar in any of the fields visited. ICP 9145 is estimated to be grown in 15 to 20 percent of the area under pigeon pea cultivation in Malawi.

Other diseases observed were not a serious problem in farmers' fields. Their distribution was also more localized than that of wilt. In the Ngabu ADD, the problems of macrophomina stem canker (4.6 percent) and root-knot were more serious, and much more in ICP 9145 than in the local cultivars. Severe root-knot infestation was also observed in some fields in Diwa Village, Kaloba division of the district of Chikwawa. The nematode-infested fields showed extensive patches of stunted growth and the galls on the roots were very large. The soils in this area were of a sandy type. Bacterial stem canker was more common in the Mechinga district of Liwonde ADD (28.3 percent). Although widely prevalent in most areas, the pathogen did not seem to cause much damage to the crop as the cankers were small and only superficial. The foliar diseases, powdery mildew and cercospora leaf spot, although also widely prevalent, did not seem to cause much yield loss either, especially in late-maturing local cultivars grown as a mixed crop. In farmers' fields, cercospora leaf spot was relatively

TABLE 3. Incidence of pigeon pea wilt from August to September 1991 in Malawi agricultural development divisions

Agricultural development division	Fields surveyed *(no.)*	Total area of fields surveyed *(ha)*	Average wilt incidence *(%)*	Range of wilt incidence *(%)*
Karonga	10	NR	6.3	0-50
Rumphi	4	NR	10.5	2-30
Nkata Bay	2	NR	11.0	2-20
Lilongwe	1	2.0	0	-
Liwonde	19	8.0	7.4	0-50
Blantyre	11	11.5	8.6	0-40
Ngabu	5	5.0	0	-
Mean			6.3	

NR - not recorded.

more common in the Machinga district of Liwonde ADD, while powdery mildew was found more in the Chiradzulu district of Blantyre ADD. Their severity, however, was very high (nearly 100 percent defoliation) on pigeon pea lines introduced from ICRISAT and grown as a sole crop at closer spacing (60 x 10 cm) at Chitedze and Makoka research stations. The greater severity of foliar diseases in the introduced lines may be the result of the higher susceptibility of the plant material to leaf spots, closer spacing and early maturity. The early-maturing lines reach the reproductive phase during the rains, and disease severity is higher during this phase. The local cultivars enter the reproductive phase only after the cessation of rains.

Variability in *Fusarium udum*

The major emphasis in the management of fusarium wilt has been on the exploitation of host-plant resistance. Several sources of resistance to the disease have been identified in India, Kenya and Malawi. Since 1976, studies at the ICRISAT International Pigeonpea Wilt Nurseries in India, Kenya and Malawi have indicated the possible existence of strains in *F. udum*. Information on the extent of pathogenic variability in *F. udum* is essential for the success of the breeding programmes on pigeon pea wilt-resistance. In 1989, ICRISAT initiated studies in India to determine variability in *F. udum*. In Kenya and Malawi, the work was initiated in 1990 with the help of the ICRISAT Deputy Director-General's funds for Africa. Here, a set of ten pigeon pea differential lines were inoculated with *F. udum* isolates collected from within the country following a root-dip inoculation and transplanting technique (Reddy and Raju, 1993). The pigeon pea lines used as differentials were ICP 2376, ICP 8858 (Sharda), ICP 8859 (NPWR-15), ICP 8862 (Hy 3C), ICP 8863 (Maruti), ICP 9145, ICP 9174, C 11, BDN 1 and BDN 2. These include cultivars originating from India (ICP 9145) and Africa (ICP 9174), and some of them, such as Maruti, BDN 2 and ICP 9145, have been released as wilt-resistant cultivars. Others, such as Sharda, showed differential reaction in the multilocation trials. Seed from plants that have been shelved for two to three years is being used. Three types of wilt reactions – no wilt, early wilt and late wilt – are being recorded. The results of the experiments carried out so far in India, Kenya and Malawi indicate that the wilt pathogen *F. udum* is variable (Reddy and Raju, 1993). However, as these studies in Malawi have been confined to isolates from the southern part of the country, during the present survey wilt samples were collected from the northern, central and southern parts of Malawi so that all producing regions of the country are represented. Isolations were made from the disease tissues and the cultures are being maintained at the Southern African Development Coordination Conference/ICRISAT Groundnut Project, Chitedze, for further investigation. It is also necessary to carry out the *F. udum* race studies with isolates from all the pigeon pea-growing countries under controlled conditions in a country where the crop is not grown. For such a study, isolates representing the major production areas in India, Nepal, Myanmar, Kenya, Malawi, Uganda and the United Republic of Tanzania need to be included.

CONCLUSIONS AND SUGGESTIONS

Fusarium wilt was the major disease of pigeon pea found in Malawi. No wilt was observed in the wilt-resistant cultivar ICP 9145 in farmers' fields as opposed to an incidence of up to 50 percent in local cultivars in some fields. ICP 9145 was also found to be highly productive in farmers' fields and research stations. It is very popular with the farmers and the only limitation to its expansion appears to be the lack of sufficient seed. It matures approximately 30 to 45 days earlier than the local landraces, and as a result it escapes moisture stress. It appears to be adapted to late sowing (March to April), as it produces a good crop compared to the almost non-existent yield of local cultivars in some places. The height of ICP 9145 was reduced in late-sown conditions. Because of its early maturity, ICP 9145 may do well at increased plant population levels in mixed cropping without suffering from moisture stress. Expanding the area under ICP 9145 with larger plant populations could be the short-term goal for increasing pigeon pea production in Malawi. ICP 9145 is uniform in maturity and most leaves shed at maturity as well. This characteristic appears to be advantageous for harvesting by hand. At some places, seed shattering was observed in ICP 9145 when the crop was left unharvested. Whether this was because of overripening or for genetic reasons needs to be studied. The increased susceptibility of ICP 9145 to macrophomina stem canker, especially in Ngabu ADD, was very discouraging. The symptoms can be confused with wilt and this aspect needs further investigation. Conversion of highly productive and adapted local landraces into wilt-resistant types can be the medium-term objective of the pigeon pea improvement programme in Malawi. Reducing the duration of the local landraces may be beneficial for certain areas such as Ngabu ADD, which is in a drier and warmer zone. When introducing plant material from other countries or breeding new lines in the country, care has to be taken that they are not susceptible to currently minor but potentially important diseases such as powdery mildew, cercospora leaf spot, bacterial stem canker, macrophomina stem canker and root-knot. Although the local landraces appear to be less susceptible to these diseases, it would be useful to assess the yield losses caused by foliar diseases of pigeon pea such as cercospora leaf spot and powdery mildew.

In Malawi, pigeon pea is now grown as a mixed crop with cereals such as maize without much rotation. Mixed cropping with maize may be helping to reduce the *F. udum* population in soil, as

intercropping with sorghum is known to reduce wilt incidence in India. Otherwise the currently cultivated local landraces, being susceptible to wilt, would have suffered much more damage under the cropping system now followed. The smallholdings of farmers in Malawi do not seem to offer much scope for crop rotation. Nevertheless, it would be useful to study the influence of different cropping systems on the *F. udum* population and wilt incidence in Malawi.

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