WORKSHOP TO DEVELOP WORKPLAN FOR BEAN PRODUCTION IN EASTERN AFRICA: COUNTRY PRESENTATION FOR MALAWI[1]

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BACKGROUND INFORMATION ON MALAWI

Geography and population

Malawi is in East Central Africa. It is bounded on the north and north east by Tanzania, on the east, south and ~~south~~ southwest by Mozambique and in the west by Zambia. The main access to the Indian Ocean is through Mozambique. The country extends for about 900 km from the north to the south and about 200 km from east to west.

The country which occupies part of the Great Rift Valley system has an area of 11.8 million hectares. Of the total area, 79.7% is land and the remainder is essentially lakes with Lake Malawi being the largest body of water in the country.

Malawi has two main distinct seasons, the dry and the wet. The dry season lasts for about seven months. May to August are cool and dry while September to October are hot and dry. The rainy season stretches from November to March generally. Rainfall is about 1,600mm in the Lakeshore and high altitude areas such as Mulanje. The plateau areas of the Shire Highlands and the Central Region receive about 875mm of rain. The Lower Shire (South), Mzimba West, and parts of Rumphi (in the north) receive less than 750mm. The Lower Shire in the South is also characterized by erratic ~~f~~rains.

The annual range of temperature is about 12°C in most meteorological stations increasing to about 15°C in the extreme South. The lowest

temperatures occur in June and July and the highest, in October and November. Temperatures in the Lakeshore and the Shire Valley average 24°C.

Population

According to the 1977 census, Malawi had a population of 5.55 million people. The growht rate was 2.9. It is estimated that the population in 1983 is 6.83 million people. The population density in 1977 was 59 persons per Km^2. Of the 5.55 million people in 1977, only 8.5% lived in urban areas of Blantyre, Lilongwe, Mzuzu and Zomba. The remainder were in the rural areas where their main occupation isaagriculture.

Agriculture in Malawi

Agriculture is the main industry in Malawi where about 90% of the population are engaged in farming and agriculture related profession. In 1980, agriculture contributed 42.6% of the gross domestic product with a rise of 9% (Anonymous 1981a). In 1977, of the 9.4 million hectares, 36% was under cultivation with 31 and 5% being under customary land (Smallholders) and estates, respectively (Table 1).

Table 1. Estimated land usage in Malawi

Parameter	Land Use (%)
Customary land under cultivation	31
Area under estate	5
Land not arable	33
National parks	11
Forest reserves	9
Urban area and infrastructure	11

The smallholder sub-sector produces the bulk of the staple foods such as maize, beans, groundnuts, rice, cassava, potatoes, etc. The export surplus from the smallholders accounted foraabout 32% of the gross domestic product in 1981 (Anonymous 1982).

IMPORTANCE AND UTILIZATION OF BEANS IN MALAWI

The common beans, Phaseolus bvulgaris L (Savi) also known by various names as dry beans, kidney beans, ration beans, sugar beans, french beans, garden beans, or simple nyemba or nchunga in Malawi, are one of the most important grain legumes. As food, beans provide high percentage of protein (20 - 25%) compared with maize, cassava and rice. Green pods and green shelled seeds are also good sources of vitamins A and C. Beans are also good sources of energy providing comparable calories as maize

flour (ufa), milled rice or cassava flour (Platt, 1962). Beans provide about two and five times more energy than bread and potatoe (Solanum tuberosum), respectively.

The beans commonly eaten in Malawi are the dry beans. These are usually red, white, speckled or tan; larged seeded (40 - 50g/100 seeds); kidney shaped seeds, which after cooking look like chunks of meat, are preferred. There are several ways of preparing bean dishes in Malawi. The commonest one in homes, boarding schools, colleges, farming estates and in most institutions where a large number of people are fed communally, is to soak the seeds in water for a few hours and discarding the water afterwards. The purpose of soaking is to accelerate cooking and also to reduce flatulence (generation of gas in the digestive system). Salt, cooking oil, tomato and other ingredients may be added according to taste and cooked as a mixture. The cooked beans (ndiwo) is served with rice or nsima. The seedcoat is sometimes removed after soaking, and the beans are cooked until soft. The beans may be mashed with a special laddle to form chipere. Beans may also be boiled with maize, after the pericarp has been removed, to produce a popular food called ngata. Beans are sometimes cooked with banana or plantain to produce a dish known as mbaraga. Beans may also be cooked in the pod and eaten as such, makata. Bean flour can also be mixed with maize flour and ground groundnuts to produce Likuni phala which is used for weaning children and for children under five years old.

The green immature pods, zitheba, are sometimes eaten as relish. Young and tender leaves are sometimes boiled and cooked with groundnut flour to produce khwanya. Surplus leaves are dried and stored for future use as mfutso. In areas where bean production is low, or at a time of the year when supply is low, beans, cowpeas (Vigna unguiculata) and pigeon peas (Cajanus cajan) can be cooked together either for the bean flavour and/or to stretch the bean supply. Other bean dishes are: baked brown beans, bean fritters, fried bean balls or mock meat loaf.

MALAWI'S GERMPLASM COLLECTION

Because of the importance of beans in the diet, a bean research programme was initiated in the early 1940's. The work was concentrated on only one variety. Because of the low genetic base, the programme was revamped in 1969 at Bunda College of Agriculture. Using extension workers, a large collection of about 4,000 lines were made from all over Malawi to form the basis for the bean improvement work. Out of the total sample, 11,285 lines were selected for evaluation (Table 2). The predominant growth habit of lines in the collection was climbing (75.4%), emphasizing the importance of maize and beans being grown in association in Malawi as compared to the dwarf which are mostly planted as pure stand on residual moisture. The main colour was solid and hardly any black seeds.

Table 2. Growth habit and seedcoat colour of beans lines in Malawi.

Growth habit	Accessions		Seed coat colour	
	Total	%	Solid (%)	Speckled (%)
Climbing	8486	75.4	70.4	29.6
Dwarf	2769	24.6	88.1	11.9
TOTAL	11,255	100.00	74.8	25.2

The germplasm material are in a "cold" room. They are rejuvenated periodically as well as collecting growth data such as emergence date, flowering date, date of fruitification, number of pods/plant, number of seeds/pod and yield as well as information on diseases and pests. It is hoped that the information would be useful in the preparation of a catalogue so as to facilitate the exchange of genetic materials among scientists. However, this aspect of our programme has been slow because of lack of facilities and staff.

OBJECTIVES OF THE BEAN IMPROVEMENT PROGRAMME

The objectives of the Malawi Bean Improvement Programme are:

1. To produce high yielding and commercially acceptable bean cultivars.
2. To provide recommendation for the production of beans both under rain-fed and irrigated condition on residual moisture as a short-seasoned rotational crop.

RESEARCH COMPLETED AND IN PROGRESS

GERMPLASM EVALUATION

Only a few of the germplasm materials bhave been evaluated at catalogued. The results obtained so far indicate that the yield potential of the collection is high with about 13% of the bush lines evaluated yielding more than 1500 kg/ha and about 8% of the climbing lines evaluated yielding over 1500 kg/hà.

The germplasm collection and evaluation process is still in progress. Materials are also being obtained from research organisations and/or individuals to broaden the genetic base.

VARIETY RELEASE

Using materials from the Malawi Bean Collection, through the process of single plant, single pod and single seed selection, we have produced four named bean varieties. These varieties are now available and are being marketed by the National Seed Company of Malawi Ltd. Some of the characteristics of the varieties are listed in Table 3.

Table 3. Some characteristics of beans on release

Name	Growth habit	Type	Seed Coat Colour	Days to Full Bloom	Seed size g/100 seed	Yield (Kg/ha)
NUasaka	Dwarf	Dry	Tan	35	49.1	1179
Bwenzilawana	Dwarf	Dry	Yellow	37	31.5	2084
Sapelekedwa	Dwarf	Dry	Red	36	49.3	1256
Kanzama	Climbing	Dry	Red	40	51.9	2739

There are also other varieties on provisional release most of which are dry and a few canning ones.

MAIZE AND BEANS IN ASSOCIATION

Mixed cropping, the practice of growing two or more crops on the same piece of land is a popular and traditional cropping system of long standing. It is a strategy used by smallholders for increasing crop yields, crop diversity, and the stability of crop production (Gomez and Gomez, 1983). According to a national sample survey of agriculture (Anonymous, 1970), 94% of the hectarage was grown to crops as mixtures. In the same survey only 1% of the pulses, beans, pigeon peas, cowpeas, etc were grown as pure stand while 99% were grown in association with other crops notably maize.

Intercropping is popular in the tropics (Francis, Flor and Prager, 1978; Igbozurike, 1977 and Francis, Flor and Temple 1976) because of several advantages. These include: increased crop yield (Wiley and Osiru, 1972, Evans, 1960, Baker, 1978 and Edje, 1982a) more efficient use of labour (Norman, 1968), more efficient use of water (Baldy, 1963), reduction in pest incidence (Pearson, 1958, and Francis, Flor and Prager, 1978) improvement in soil fertility (Agboola and Fayemi, 1972). Despite the above advantages, little research has been done on mixed cropping until the 1970's when researchers started "going outside the research stations and talking to the farmers who have been experimenting with intercropping for centuries.

In view of the above we have conducted mixed cropping trials on the following crop combinations:

a. maize and beans

b. maize, beans and pumpkins

c. sorghum and beans

d. cassava and beans

e. groundnuts and beans

f. tobacco and beans

g. Acacia albida and beans

h. Leucaena and beans

i. Eucalyptus and beans, and

j. Gmelina and beans

The strategy in these crop combinations has been designed to ensure that the yield of the main crop, usually maize, is not reduced. Consequently yield increases as high as 62% have been reported (Edje, Mughogho and Rao, 1976). Land equivalent ratios as high as 1.4 have also been reported (Edje, Mughogho, Rao and Msuku, 1981).

Using Food and Agriculture oOrganisation estimates that a 55-kg active man requires 2.5 megacalories and 65g of energy and protein per day, we have been able to show from calculations that more farmers can be fed on produce from mixed than sole crop. This is important since most farm work is done by hand, operations that need high energy food for hard work Ngwira (1981) working on the intercroppigg of maize,

bean and pumpkins (Cucurbita maxima) showed that maize yield was not significantly affected when grown in association with either beans or pumpkins (Table 4). The bean and pumpkin yields were therefore a bonus crop to the farmer since all three crops were grown on the same piece of land utilizing the same fertilizer meant for maize. She also showed that about two months lafter planting, the pumpkins had completely covered the ground. This, she noted, reduced the frequency of weeding in plots where pumpkins were grown. This is of importance to the smallholder who uses hand tool for almost all field operations.

Table 4. Yield (kg/ha) of maize, beans and pumpkins in monoculture and in association at Bunda College, 1981.

Crop combination	Maize	Beans	Pumpkins
Maize alone (MH12)	6981	-	-
Bean alone (Climbing; var. 1039)		1073	-
Pumpkin (local variety)	-	-	24,478
Maize and beans	7182	222	
Maize and pumpkins	7037	-	10,057
Beans and pumpkins	-	784	13,793
Maize, beans and pumpkins	6138	157	13,602

In recent years, there has been an increased need to integrate crop production and livestock production in Malawi (Spurling, Spurling

and (Bowmaker, 1972). Taking an advantage of mixed cropping as a popular cropping system, we at Bunda College began investigating the effect of topping maize, either removing tassel alone or tassel with some leaves on the yield of maize and beans. The basic objective is to feed the topped maize part as green feed or as dry fodder to fattening steers. It was also hoped that by topping, more light would become available to the associated bean crop. The data in Table 5 show the effects of these treatments on crop yield (Edje unpublished and Kubwalo, 1981)

Table 5. Seed yield (kg/ha) of topped maize in monoculture and in association with beans.

Treatments	Maize Yield		Bean Yield	
	Mono	Assoc.	Mono	Assoc.
No topping of maize	7423	6383	2221	774
Top tassel only	8067	6605	-	741
Top tassel and 2 top leaves	7850	6364	-	652
Top tassel and 4 top leaves	6928	5574	-	864

Kubwalo (1981) reported that assuming that one livestock unit equals 454 kg and if one livestock unit feeds on 11.4 kg per day and if it takes five months oto fatten a steer for slaughter, topping tassel only, tassel plus two leaves and tassel plus four leaves should provide eacnough feed for 1, 2 and 3, livestock units/hectare, respectively (Table 6).

Table 6. Dry matter and no. of livestock units to be fed on topped maize plant parts

Treatments	DM (kg/ha)	Day/L.U.	L.U./ha
Top tassel only	2390	209	1
Top tassel and 2 leaves	3280	287	2
Top tassel and 4 leaves	5240	451	3

A recent survey (Anonymous, 1981b) showed that 94% of the energy consumption in Malawi is from fuelwood where wood is used for heating and cooking in urban as well as in rural areas. In addition to the above, the checklist of wood use included: curing tobacco, smoking fish, baking bricks, furniture use, houst construction, canoe building, etc. Because of the importance of trees in the economy of the country and the role of trees in maintaining the fragile ecosystem, there has been renewed interest in the re-marriage of agriculture and forest and also livestock in an old land use system now referred to as agroforestry.

One of the areas of agroforestry is the investigation in the integration of crops and trees. Preliminary results (Edje 1982 b, 1982c) showed that beans can be grown successfully under trees during the first year of tree's establishment with reasonable crop yields (Table 7) in what may be termed as the taungya system.

Table 7. Effects of planting trees in monoculture and in association with beans

Cropping sys

Cropping system	Bean yield (kg/ha)
Monoculture	1578
In association with:	
Acacia	1342
Eucalyptus	1282
Gmelina	1292
Leucaena	1390
S. E. ±	76

PLUCKING LEAVES FOR USE AS GREEN VEGETABLE

As indicated earlier under utilization, both bean pods and tender leaves are plucked before pod set, cooked and eaten or parboiled, dried and later as vegetable. Edje, Mughogho and Ayonoadu (1972) reported that plucking bean leaves for use as vegetable reduced seed yield significantly. For example plucking three leaves once or twice reduce seed yield of bush beans by 21 and 40.8%, respectively. Climbing beans were less affected by plucking.

Edje (1981a) investigating the effects of initrogen and leaf remov removal reported that while nitrogen increased seed yield significantly additional nitrogen did not produce enough leaves to offset the effect of lea

of leaf plucking (Table 8).

Table 8. Effects of nitrogen and leaf plucking on seed and leaf yield

N leaves (kg/ha)	No. of pluckings	Seed yield S(kg/ha)	Fresh leaf yield (kg/ha)	Leaf Area Defoliated (dm^2)
0	None	799	-	-
	One	621	1875	67
	Two	555	3034	130
	Three	273	4891	156
	Mean	562	3267	118
40	None	1096	-	-
	One	1034	2933	98
	Two	1164	5298	163
	Three	701	5922	195
	Mean	999	4718	152
80	None	1125	-	-
	One	1287	648	101
	Two	1015	960	172
	Three	737	1230	187
	Mean	1041	946	153
S.E. ±	N levels	48	245	7
	Leaf plucking	89	165	3
	N X Leaf plucking	154	213	6

USE OF LEUCAENA PRUNINGS AS FERTILIZER

Recent increases in fertilizers and the general shortage of fuelwood in the tropics has renewed interest in the use of green manures. Because before the introduction of modern agriculture, farmers in the tropics were of necessity organic farmers. That is they used neither commercial fertilizer nor pesticides.

Trial conducted at Bunda College during the 1982/83 crop season (Edje, 1983, Figure 1) showed that additional fresh leucaena prunings increased bean seed yield significantly. Seed yields for 0, 10, and 20 tonnes/ha of leucaena were 915, 1160 and 1706 kg/ha, respectively. Both 15 and 20 tonnes/ha of leucaena yielded higher than 250kg/ha of a compound fertilizer (20-8.7-0; N-P-K).

GROWING BEANS ON RESIDUAL MOISTURE ON IRRIGATION SCHEME.

There are 16 irrigated settlement schemes in Malawi occupying an estimated area of 4147 hectares and an expansion is planned. Settlement schemes that have adequate irrigation facilities have two crops of rice yearly; while those that do not have adequate water supply produce only one crop of rice leaving the land idle for the remainder of the year. In 1980 several adaptive research trials were initiated aimed at producing package practices for bean production on residual moisture following a rice crop.

The results of variety trial showed that a mean seed yield of 1691 kg/ha could be obtained. The results of other trials showed that beans planted about mid June anhad the highest seed yield of 2100 kg/ha. Planting beans at that time would provide ample time for the crop to mature and to prepare land for a subsequent crop of rice. Preliminary results also showed that a seed rate of 50 kg/ha or a plant population of 111,000 plants/ha grown on flat with 45cm between rows had the highest seed yield of 1589 kg/ha. Increasing the seed rate to 100 kg/ha. reduced seed yield by 18.4% (Edje, 1982d)

PLANT POPULATION AND PLANTING PATTERNS

Plant populations on farmers fields is usually rather low 30,000 - 80,000 plants/ha presumably because of shortage of seeds or because of

planting patterns which is usually hill planting, excepting in parts of the Northern Region where farmers plant three to four crows on ridges about one meter apart. Earlier work on plant population (Edje, Ayonoadu and Mughogho 1974 and Edje, Ayonoadu and Mughogho 1975) showed that beans were highly plastic and were able to compensate for yield even at low plant densities.

Recent work (Table 8) showed that, at the same plant population, planting pattern ahad effect on seed yield.

SEED INOCULATION

Earlier work (Edje, Ayonoadu and Mughogho 1975a) showed that beans responded to liberal dressings of nitrogen. However, prices of fertilizer in Malawi, as elsewhere, have brisen 293%l in a decade. At this price increase, the purchase of fertilizer has become less attractive.

However, trials on seed inoculation with Rhizobium bacteria have not produced appreciable seed yield increases compared with nitrogen fertilizer (Edje, 1983a, Figure 1)

SEED STORAGE

The commonest storage pest of dry beans in Malawi is Acanthoscelides obtectus. It is not uncommon to see an entire bean crop destroyed by the pest within two to three months after harvest. This insect problem has been one cause of lack of seed for planting.

However, during a bean germplasm collection trip in Northern Malawi

in 1982 we saw farmers storing beans with pod ash. The farmers we spoke to said that the use of the pod alone was more effective than when the ash was obtained from the entire plant (less the seeds of course). The data in Tables 9 and 10 show the results of beans after eleven months in storage. The seeds were stored in metal tins with 3 kg of seeds per tine. Not only did the pod ash protect the seeds in storage, seeds stored in pod ash had more shining appearance than those stored in other "insecticides".

Table 8. Seed yield of six bean varieties at three planting patterns

VARIETIES	PLANTING PATTERNS			MEAN
	One row per ridge (5 cm apart)	Two rows per ridge (10 cm apart)	One row per ridge Hill planting (20 cm apart)	
253/1	1340	1464	1233	1346
1196	1822	1952	1762	1845
P692	1879	2250	1840	1990
P40[illegible]	2032	1896	2072	2000
336	2007	1607	1557	1724
103[illegible]	896	968	1090	1015
MEAN	1678	1690	1592	

Table 9. Effects of various insecticides on bean storage

Insecticides	No. insects/kg seed		Weevilled Seeds (%)	
	Alive	Dead	Not weevilled	Weevilled
Control	25	661	50	50.0
Groundnut oil	51	496	74.7	25.3
Sunflower oil	1376	743	56.7	43.3
Tobacco dust	3	394	88.0	12.0
Actellic	1	1266	87.0	12.2
Bean Pod ash	3	161	92.0	8.0
Bean Varieties				
253/1 (Tan)	27	465	58.8	41.2
336 (Red)	50	826	72.8	27.2
499/5 (Black)	16	581	83.0	17.0
P692 (White)	53	609	66.5	33.5

Table 10. Germination (%) of 4 bean varieties stored with six insecticides

Insecticides	V A R I E T I E S				M E A N
	253/1	336	489/5	P692	Mean
Control	36.4	69.2	61.2	36.0	50.7
Groundnut oil	82.8	58.8	68.0	64.0	68.4
Sunflower oil	24.0	37.2	46.8	30.8	34.7
Tobacco dust	89.2	66.8	77.2	89.2	80.6
Actellic	97.2	76.0	78.8	86,8	84.7
Bean pod ash	98.8	86.8	77.2	92.0	88.7
M E A N	71.4	65.8	68.2	66.5	

BEAN/COWPEA CRSP PROJECT

The title of the Malawi Bean/Cowpea CRSP Project is "Genetic, Agronomic and Socio-cultural Analysis of Diversity Among Bean Land Races in Malawi".

The objectives of this project are:

1. To produce a quantitative estimation of the diversity within and between the bean land races which about 75% of the farmers grow.
2. To determine which plant or seed characteristics play major roles in distinguishing one race from another.
3. To obtain objective descriptions of major agronomic and climatic factor

factors and biological forces operating in the environments in which genetic diversity prevails.

4. To determine the socio-cultural considerations that might be associated with preference for and acceptance of particular land races or components of such races.
5. To identify the contribution of farm women to bean production and consumption and their relationship to the central problem of reasons for maintenance of genetic diversity.
6. To develop a synthesis of agronomic genetic and socio-cultural factors that would explain the diversity patterns observed in Malawi and reasons for their maintenance.

ACTIVITIES SINCE INITIATION OF PROJECT

1. GERMPLASM COLLECTION IN THE NORTH, 1982

An intensive germplasm collection trip was made in the Northern Region of Malawi in Easter of 1982 with co-investigators from the Michigan State University and the host country investigators. In all a total of 113 samples were collected.

During the collection, farmers were asked the source and or origin of their seeds, how long they have been growing beans, agronomic practices (time of planting, mixed or pure stand, fertilizer application), reasons for growing several types of beans, utilization, preference, methods of preparation, storage and sales of surplus.

Of the 113 collections, 28 were made from markets and 85 from farmers' fields and/or homes.

The percentage distribution of types grown are shown in Table 11. The number ranged from 1 - 63 and a mean of 14 types per sample.

Table 11. Percentage of types of cowpeas in the Northern Collection

No. types	Percentage
1 - 5	25
6 - 10	23
11 - 15	15
16 - 20	10
21 - 25	7
26 - 30	11
31 - 35	5
36 - 40	1
41 - 45	0
46 - 50	1
51 - 55	0
56 - 60	1
61 - 65	1

Majority of the types were medium to large in size, kidney shaped and seed coat colours ranged from brown, green, red, speckled to white and an occasional blue.

Most of the farmers owned their own seed, some having obtained the seeds from their grandparents. The crop was generally planted in mixed stand with maize where the later crop provided stake for the bean crop. Two crops of beans were possible in some areas. The second crop was either relay with beans or grown as a pure crop following a maize crop.

Double cropping where beans followed maize was common in the Misuku area. In this area, beans were grown in association with a short-seasoned maize variety. The maize was harvested after physiological maturity but before it was completely dry for storage. The maize was dried on a "shelf" over fire from cooking. Some maize leaves were stripped from the plant, buried and new ridges made and a second crop of beans were planted. The second crop was generally a bush or semi-climber. Some of the Agricultural Extension workers said that farmers were reluctant to accept long duration hybrid maize because it interfered with the second crop of beans. In some areas, a third crop of beans can be grown either on redisual moisture or near a stream.

Farmers did not apply fertilizer to beans. However, where beans and maize awere grown in association, the maize crop was often fertilized

As stated earlier, farmers grew several types of beans. The reasons

givengwere for yield stability and a strategy for stretching the availability of leaves and seeds for food and also for reasons of preference and sales for cash as the small reds, Katolika, were often planted because they were high yielding, takes too long to cook and sours rapidly after cooking.

The red kidney, Saaba, sugar beans, Serenje, the dark reds, Chazama the green, nyauzembe, cream with olive stripes, mwangulungulu etc. were generally preferred either because of taste and/or ease of cooking. Mwangulungulu was said to be good for children while some of the dark reds, mazungu, were said to cause stomach problem for children.

The small whites and to some extent the large whites were easy to cook but soured easily and stored poorly. Some farmers used the ash t from the pods for storage. Surplus seeds were sold at village markets to a produce buying organisation, Agricultural Development and Marketing Corporation (ADMARC). ADMARC paid premium price for monocoloured seeds thereby discouraging farmers from selling blends. Since farmers grew beans as mixtures of types, seeds were, therefore, selected before they were sold to ADMARC.

SOCIO-CULTURAL STUDY

Following the initial seed selection in the North, ten women students from Bunda College were trained as interviewer-observer by

Dr Pat. Barnes-McConnell and Dr J Miller with assistance from Dr O T Edje and Mr A Mkangama. These ladies spent two and half months with Dr J Miller and Mr A Mkangama collecting socio-cultural data on bean production and special emphasis bean utilization.

Data collected from household included demographic information about the family, general information about the homestead and the provision and/or availability of production of , production of beans consumption labour preparation and consumption of beans, storage and disposal of surplus. The results of this socio-cultural survey should be available soon.

RANDOM COLLECTION OF BEANS THROUGHOUT MALAWI

The objective of this collection was to obtain at random single plant selection at harvest or random bulk sample of already harvested crop to obtain quantitative estimates of the genetic diversity of beans in Malawi. To this effect, 13 farms were selected in bean growing areas with five sites each in the North and the Central Regions and three in the South. In all 65,309 seed samples were collected from sites that ranged from 930 - 1728 meters above sea level. The number of seeds per region and the frequency of seeds of three major seed coat colours are shown in Table 12. The North had the highest number of seeds, also the highest frequency of all types of seed coat colours. The reason for the high frequency in the North compared to the other two

regions is not quite understood but it is probably that market economy where ADMARC paid premium for monocoloured seeds could be a determining factor. Farmers in the North tended to sell their beans locally or to neighbouring countries where the pressure for monocolour is less pronounced.

Table 12. Mean altitude, no. samples and frequency of seed types iby colour in three regions of Malawi

Region Region	Mean Altitude (m)	Sample of seed size	Seed Frequency		
			Mono	Var.	Zebra
North	1312	28678	.302	.101	.037
Centre	1098	18299	.196	.067	.016
South	1833	18332	.224	.057	.00005

Table 13 shows the pattern shape, the frequency of colours and the different types pooled over regions.

Table 13. Seed pattern and shape of seeds from 13 farms in Malawi &

Seed character		Frequency	No. Types
Pattern			
	Monocolour	0.72	23
	Variegated	0.23	62
	Zebra	0.05	27
	TOTAL	1.00	112
Shape	Ratio:L/b		
	Globe	Ratio:L/b	0.22
	Oval	1.5 - 1.75	0.63
	Oblong	> 1.75	0.15

There were 112 different seed types with the variegated representing 55% of the types and the monocolour or plain (Solid colour) and the zebra being 21% and 24%, respectively.

GERMPLASM EVALUATION OF SEEDS COLLECTED - NORTHER REGION:

The 113 seed samples which were collected in Easter, 1982 were planted under irrigated and rainfed conditions at Bunda College. Data were collected on agronomic characteristics such as hypocotyl colour, flowering, growth habit (according to IITA classification) and also

on seed characters. The seeds are being increased for future agronomic studies.

GERMPLASM COLLECTION -CENTRAL REGION 1983

During the second germplasm collection in 1983, only 50 samples were collected from the Central Region. The number of types ranged from 1 to 35 with a mean number of 15 types per farm, about the same number as for the North but the range of types and colours were much less in the Central Region.

RESEARCH NEEDS

1. FARMING SYSTEMS RESEARCH APPROACH TO BEAN RESEARCH

Until the 1970s the traditional form of agriculture research which was rather prescriptive and permitted the researcher and the extension worker to isolate the farmer and pass on to his client only the best results and recommendation was the vogue. Trials were conducted under ideal research station with much more fertile soil, better management conditions, complex treatments whose interactions are difficult to interpret for the benefit of the smallholder farmer.

What is needed, and urgently too, is a detailed farm to obtain information on production areas, production systems and constraints as well as utilization. The survey should be done during the growing season so that the participants have an opportunity to see the crops in the field.

2.
2. COLLECTION AND EVALUATION OF GERMPLASM

More detailed collection with climatic data, soil information, altitude etc. of germplasm is still needed. Where farmers grow two or more crops during the year, different collection trips should be made since farmers are likely to grow different types during the different seasons.

The evaluation of the germplasm with the view to a comprehensive cataloguing of the material collection is also needed. This is a vital information not only for the collector but also to other bean researchers.

3. VARIETAL IMPROVEMENT

Until about a year or so ago, we were quite enthusiastic about producing one or two varieties for production in Malawi. However, after the field trips we made to the North and the Central Regions of Malawi where the average number of type per farm is 14 - 15, I am beginning to wonder about the justification of developing one or two varieties for farmers to grow.

4. MIXED CROPPING

Growing of beans in association with maize is the most predominant cropping system of growing beans in Malawi. Studies are needed on relative dates of planting; plant density in mixed cropping, planting patterns in mixed cropping, diseases and pest complex. Studies are also needed on relay and double cropping.

5. PLANT DENSITY

Most farmers in Malawi plant beans in hills as a pure stand as a double crop following a maize crop. Research is needed on lthe of cultivars to low density and hill planting on residual moisture.

6. CROP NUTRITION

The ever rising price of nitrogenous fertilizer justifies more search for effecient nitrogen fixing strains of Rhizobium.

CROP PROTECTION

The commonest diseases in Malawi are enthracnose, halo blight and angular leaf spot. Bean fly is the commonest field insect pest especially of late planted crop or where the farmer has a double crop of beans. Resistant varieties to the above pests are needed as a matter of urgency.

SEED STORAGE

With respect to seed storage, research is needed in the evaluation of local materials for seed storage. As reported earlier, the ash from bean pods have been used fairly successfully. Nevertheless, there is need to screen for bean pods with insecticidal qualities for bean storage and also the proportion of ash to seed during storage.

ENERGY FOR COOKING BEANS

In Malawi, 94% of the energy consumption is wood, where fuelwood is used for cooking and heating. However, wood supply is becoming a

problem. This scarcity is bound to affect the frequency of bean consumption. Because of the energy demand for cooking beans. Already some more urban dwellers are beginning to cook beans using charcoal instead of electricity because of high electricity bills. Even the frequency of using charcoal is decreasing because of its cost and that of fuelwood.

There is urgent need therefore to search for easy to cook varieties otherwise bean consumption and by logical extension bean production will decrease.

SOCIO-CULTURAL STUDIES

Recent observation in Malawi showed that women played an important role in all aspects of bean production right from lthe choice of "cultivars to plant, land preparation, the actual production, havesting, utilization, storage and marketing of surplus. However, their influential role in bean production is hardly rerecognised and therefore, unfortunately never mentioned in the literature. It is hoped that a socio-cultural study would show the contribution of women to bean production and this might help in designing training programmes at the village level aimed at increasing bean production and utilisation as well as in the preservation of germplasm.

LITERATURE CITED

1. Agboola, A.A. and Fayemi, A.A. 1972. Fixation and excretion of nitrogen by tropical legumes. Agronomy Journal 64: 407 - 412.
2. Anonymous 1970. National Sample Survey of Agriculture, National Statistics Office, Zomba, Malawi.
3. Anonymous 1981a. Economic report: Budget document No. 41. Government Printer, Zomba.
4. Anonymous, 1981b. Woodfuel in Malawi. Paper presented at a Seminar on study tour for the promotion of regional cooperation in the technology field among countries from East and Southern Africa. Lilongwe, Malawi. 17 Feb. 1981.
5. Anonymous. 1982. Economic report budget document No. 4. Government Printer, Zomba, Malawi.
6. Baldly, C. 1963. Mixed cultures and water utilisation. Annals of A Agronomy 14: 489 - 534.
7. Edje, O.T. 1983a. Response of Phaseolus beans to seed inoculantiann AND NITROGEN FERTILISER. Paper presented at MIRCEN Coordinating Board Meeting 30 May - June, 1983. Lilongwe, Malawi.
8. Edje, O.T. 1983b. Response of maize and beans to Leucaena prunings. Paper presented at Agroforestry Workshop. 28 June - 1 July, 1983. Lilongwe, Malawi.
9. Edje, O.T. 1982a. Comparable development, yield and other agronomic characteristics of maize and groundnuts in monoculture and in association. Paper presented at Second Symposium on Intercropping

for the Semi-Arid Areas. Morogoro, Tanzania 4 - 7 August, 1980.

10. Edje, O.T. 1982b. Agroforestry: Preliminary results of inter-planting Gmelina with beans maize or groundnuts. LUSO: J. Sci. Tech. 3: 29 - 32.

11. Edje, O.T. 1982c. Agroforestry: An integrated landuse system for increasing agricultural productivity. Paper presented at a Conference on "Development in Malawi in the 1980s." Progress and Prospects. Zomba, Malawi. 12 - 14 July, 1982.

12. Edje, O.T. 1982d. Growing beans on residual moisture after a rice crop. LUSO: Journal of Science and Technology 3: 105 - 117.

13. Edje, O.T. 1981b. Effects of nitrogen and leaf removal on Phaseolus bean yield LUSO: Journal of Science and Technology 2: 39 - 51.

14. Edje, O.T., Mughogho, L.K., Rao, Y.P., & Msuku, W.K., 1981. Bean Bean Production in Malawi in proceedings of Potentials for field beans in Eastern Amrica, 9 - 14 March 1980, Lilongwe, Malawi.

15. Edje, O.T. Mughogho, L.K., a& Rao, Y.P., 1976. Effect of mixed cropping of maize and beans on seed yield. Annual Report of Bean Improvement Cooperative 19: 31 - 34.

16. Edje, O.T., Mughogho, L.K. and Ayonoadu, U.W.U. 1975. Bean yield and yield components as affected by fertilizer and plant population. Turrialba. 25: 79 - 84.

17. Edje, O.T., Ayonoadu, U.W.U. and Mughogho, L.K. 1974. Response of indeterminate beans to varying plant populations. Turrialba 24: 100 - 103.

Udje, E.J., Mughogho, L.K. and Ayonoadu, U.W.U., 1972. Effects of leaf removal on the yield of Phaseolus beans. Malawi Journal of Science. 1: 10 - 14.

19. Evans, A.C. 1960. Studies of intercropping maize and sorghum with groundnuts. East African Agriculture and Forestry Journal 26: 1 - 3.

20. Francis, C.A., Flor, C.A. and Prager, M. 1978. Effects of bean association on yield components of maize. Crop Science 18: 760 - 764.

21. Francis, C.A., Flor, C.A. and Temple, S.R. 1986. Adapting varieties for intercropped systems in the tropics. P. 235 - 253. IN Papendick P.A. Sanchez; and G.B. Triplett (eds). Multiple cropping. ASA Special Publication No. 27.

22. Gomez, A.A. and Gomez, K.A. 1983. Multiple cropping in the humid tropics of Asia. Ottawa, Canada, 248 pp.

23. Igbozurike, U.M. 1977. Agriculture at the Cross road: A Comment on agricultural ecology. University of Ife Press, Ile Ife, Nigeria.

24. Kubwalo, F.X.F. 1981. Effects of topping maize and intercrop planting with beans on yield and yield components. Degree Year 5, Project, Bunda College of Agriculture, Lilongwe,

25. Ngwira, P. 1981. Growing maize, beans and pumpkins in monoculture and in association. Degree Year 5 Project. Bunda College of Agriculture. Lilongwe, Malawi

Norman
26. Norman, D.W. 1968. Why practice intercropping? Samaru Agricultural Newsletter 10: 107 - 116.

27. Pearson, E.D. 1958. The insect pests of cotton in Tropical Africa: Commonwealth Institute of Entomology. London 355p.

28. Platt, B.S. 1962. Tables of representative values of food commonly used in Tropical countries. Medical Research Council. Special Report Series No. 302, London.

29. Spurling, A.T., Spurling, D. & Bowmaker, R. (1972. Stallfeeding of beef cattle, organisation and experimental work in the Southern Region. Research Circular No. 9/22. Extension Aids Zomba, Malawi.

30. Willay, R.W. and Osiru, D.S. 1972. Studies in Mixtures of dwarf sorghum and beans (Phaseolus vulgaris) with particular reference to plant population. Journal of agricultural science 79: 531 - 540.

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