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RECOMENDATIONS FOR BEAN PRODUCTION IN MALAWI

1. INTRODUCTION

A. IMPORTANCE

The common beans, Phaseolus vulgaris L., also known by various names as dry beans, kidney beans, ration beans, sugar beans, french beans, haricot beans, garden beans, snap beans, string beans, bush beans, pole beans or nyemba, are one of the most important food grain legume crops in Malawi being second only to groundnuts in total production among the grain legume crops.

As food, beans provide high percentage of protein compared with maize, rice or cassava. Green pods and green shelled seeds are also good sources of vitamins A and C. In addition to the protein supply, beans are also a good source of energy providing comparable values of calories of maize flour, milled rice or cassava flour. They provide about 1.5 to 4.5 times more energy than bread and potato (Solanum tuberosum), respectively. In addition to providing subsistence needs, surplus beans can be sold because there is high demand for domestic use and there is good export market for it .

B. UTILIZATION

The beans most commonly eaten in Malawi are the dry beans. These are the red, white, speckled or tan large seeded (40-50 grams/100 seeds); kidney shaped seeds, which after cooking look like small chunks of meat, are preferred. There are several ways of preparing bean dishes in Malawi. The commonest one in home, boarding schools, colleges, farming estates and 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 secondarily to reduce flatulence (generation of gas in the digestive system). Salt, pepper, cooking oil, tomato and other ingredients may be added according to taste to the bean mixture and cooked. This "ndiwo" is served with ufa or rice. The seed coat is sometimes removed after soaking, and the beans are boiled till soft. They are mashed with a special stick or laddle to form "chipere". Beans are also boiled together with maize from which the pericarp has been removed to produce a popular dish called "ngata". Beans are cooked with bananas to produce a dish known as "mbaranga". Beans may also be cooked in the pods, "makata", and eaten with no accompanying porridge. Bean flour is also a constituent of

"Likuni phala" which is used for weaning children and for children under five.

The green immature pods, "zitheba", are commonly eaten as relish. Young and tender leaves are also boiled, and groundnut flour may be added to taste ("khwanya"). Any 'surplus' leaves are dried and stored for future use as "mfutso". In areas where bean production is low or at the time of the year when the supply is low, beans, cowpeas (Vigna unguiculata L.) and pigeon peas (Cajanus cajan L.) can be cooked together either for the bean flavor and/or to stretch their supply. Other bean dishes are: baked brown beans with bacon joint, brown beans in oil, beans flitters, fried bean balls and mock meat loaf.

C. TYPES OF BEANS

1. Growth habit

On the basis of growth habit, beans are divided into:
a. dwarf, bush or determinate;
b. semi-climbing, indeterminate;
c. climbing, indeterminate.

The dwarf varieties are short, erect with about 10 nodes and do not need support when planted. The main stem terminates in an inflorescence. Maturity is about 90-100 days after planting.

The semi-climbing varieties have their main stem longer than their branches. They are weak climbers and can grow longer than the dwarf. The climbing varieties are the commonest types in Malawi where they are grown in mixed stand with cereals, notably maize. These varieties have relatively long thin stems with long internodes , few branches. Because of their weak stem, they normally grown with support, a cereal, so as to increase seed yield and quality. Because the support or stake exposes the leaves to better to better light utilization and the pods are raised above the ground to reduce spoilage from microbial growth.

Unlike the dwarf, the last node is vegetative and growth period for the crop can last up to 120 days.

2. USES:

Beans can also be classified into types based on uses. These are :
A. dry beans
B. canning beans
C. seed

Dry beans are the commonest type in Malawi. These are medium-to-large sized kidney , round, oval, or oblong shaped beans which range in colour from red or white to speckled.

They are usually harvested when the pods are fully dry; the dry seeds are cooked. The pods are parchment (fibrous) and dehisce on both seems when dry. The second type is canning beans. These are white and roundish in shape and are grown for their dry seed which are canned. Because of the stringent seed quality requirements, especially for colour and splits production under irrigation is prefer to rain-fed crop. ADMARC's canning factory, Mulanje peak, cans these beans in tomato sauce.

The third type, seed beans , also known as french beans are usually eaten green because their pods are tender. The pods do not split open when dry and has thick fleshy pods when green with relatively small seeds. Sometimes seed beans can be canned. At the moment the production of seed beans is aimed at producing seeds for export so that the seeds can be grown for green beans overseas.

2. RAIN-FED CROP

A. LAND PREPARATION AND TYPE OF SEEDBED

Beans can be planted on ridges 91cm apart or on flat. Land should be prepared before the rains since it might be difficult to get into the field after the rains have started.

B. VARIETIES

1. Dwarf (bush or determinate) varieties

a. Nasaka (253/1) - tan seed coat colour kidney-shaped.

b. Bwenzilawana (373) - yellow seed coat, roundish.

c. Kamtsilo(499/1) - blue seed coat colour kidney-shaped.

d Sapelekedwa (600/1) - red seed coat colour, kidney-shaped.

2. Climbing (pole or indeterminate) varieties

The national seed compony of Malawi Limited also sells the following varieties:

a. Kanzama (97/1) - red seed coat colour, roundish.
b. Namajengo (336) - red seed coat colour, roundish.

The above varieties can be purchased from ADMARC in Karonga ADD, Mzuzu ADD, Kasungu ADD, Lilongwe ADD, and Blantyre ADD. They can also be purchased from other seed dealers.

C. SEED RATE

1. Dwarf varieties
80-90 kg/ha

2. Climbing varieties
75-90 kg/ha

D. TIME OF PLANTING

Plant at such a time that the beans mature in dry weather. The dwarf and climbing beans take about 90-100 and 100-110 days, respectively, to mature. Suggested time of planting for the Southern Region is about late December to mid-January while in the Central Region, about early January to late January.

E. FERTILIZERS.

In the absence of soil test results the following can be used:

1. TYPE
Use compound fertilizer 20-20-0 (N-P2O5-K2O)
Beans fix very little amount of nitrogen hence nitrogen is needed for reasonable yields.

2. RATE

Apply 200-300 kg/ha of 20-20-0 or 23:21:0

3. METHOD OF APPLICATION

Band fertilizer in a groove on ridges and plant about 10cm away from the band. If planted on the flat, band on flat and plant 10cm also from the fertilizer band.

4. TIME OF APPLICATION
Just before planting. Only the basal application is needed because beans are a short seasoned crop and it is not economical to side dress with nitrogen execept perhaps under irrigation.

F. PLANT POPULATION AND SPACING

1. DWARF BEANS

a. Ridges

Plant about 222,000 plants/ha. This is achieved by planting two rows of beans on ridges which are made 91cm apart.The distance between the row should be about 30cm apart. The fertilizer is banded between both rows and coverd. The distance between plants within each row is 10cm. Plant one seed per station. Fill gaps (supply) within one week after emergence.

b. Flat

The same population as for ridges. However, the seed should be planted in rows 45cm apart. The distance between plants within the row should be 5cm apart. If it is machine planted, the planter should be calibrated to deliver about one seed every 5cm. The seed row should be about 10cm from the fertilizer band.

2. CLIMBING BEANS

a. Ridges

Plant population is about 73,000 plants/ha. This can be achieved by planting on ridges 91cm apart and 15cm between plants on the ridge. Plant single row per ridge.After applying fertilizer on the ridge,it is covered and seeds are planted on top of the ridge over fertilizer band. It is, therefore,essential to ensure that the fertilizer is at least 5-7cm below the seed.

b. Flat

Plant in rows randing from 60cm to 91cm apart. The choice depending on the tractor drawn implement avalabie.Closer distance between rows are prefered since they yield more

and control weeds more effecietly because plants grow and cover the distance between rows much more rapidly. The distance between plants within rows can be adjusted to achieve a plant population ranging from 73,000 to 111,000 plants/ha.

C. SUPPORT FOR CLIMBING BEANS

This is not economic on a commercial scale although results have shown that both seed yield and quality are reduced by as much as 50% when climbing bean plants are not provided with support. The reduction in seed yield of unstaked bean is becauce of poor leaf exposure to sunlight Poor seed quality is attributed to pods resting on the soil where water and soil splashing on them increase microbial growth on and inside the pod and the seed.

H. DISEASES

The commonest bean disease in Malawi is halo blight, a bacterial disease. This can be controlled by spraying with a fungicide called copper oxychloride. The chemical is available from shell chemical in Blantyre and Lilongwe.

The chemical should be sprayed at the rate of 4.5g of commercial product per one litre of water and sprayed on the crop to run off.Effective control is achieved by spraying at two weekly intervals. Anthracnose, Angular leafspot, and web blight are other diseases.These can be conrolled by the use of daconil at 3.5g of commercial products in one litre of water.Spray to run off at two-weekly intervals.

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I. INSECT PESTS

Most insect pests are leaf beetles. Use dipterex 95% S.P. at the rate of 1.5g of commercial product per one of water and spray as needed.

J. WEED CONTROL

1. Hand weeding (with hoe)
Weed two to three times depending upon the weed situation. No banking after pod set because this raises the height of the ridge bringing the soil too close to the pod or even at times touching the pod resulting in low quality seeds.

2. CHEMICAL WEED CONTROL

Use Lasso or dual at three litres of commercial product per hectare.

NOTE:

Trial have shown that weed control during the first 30 days or so is very ciucial in bean production.Delay in weed control until after this time seems to be a waste of time since yield reduction from weed competition after this time cannot be compensated for from the late weeding.

Harvest in mid-morning.Pods harversting too early in the morning are rather wet from dew and may rot if not properly dried. If harversting is too late in the day,the pods dehisce (split open) easily resulting in low yield from seed loss. The seeds are difficult to pick after the pods have shattered.

L. SHELLING

Seeds meant for planting are better shelled by hand so as to prevent splitting when the pod are hit or flogged with sticks. Seed resulting from such shelling procedure usually have cracked coats, and sometimes split cotyledon that lead to loss of seed viability.

Seed meant for food can be shelled mechanically with an appropriate sheller driven by tractor or manually operated. When shelling is by hand or with a sheller, shelling is simplified by first of all drying the pods in the sun. Pods so

treated split open quite thus increasing the rate of shelling.

M. STORAGE

Beans are easily [illegible] by weevils even before they are harvested especially if harvesting is delayed. Therefore, proper storage after shelling is rather important. Use actellic dust at the rate of 115-120g per 100kg of clean and sorted seeds. For small quantity meant for seed (planting) beans can be stored in ash, tobacco dust or use cooking oil such as covo (if there is enough to spare from cooking). Rub the oil on the seed thoroughly using about 200-250 cc per 100kg of seed.

N. MIXED CROPPING BEANS WITH MAIZE

Mixed cropping, which is the system of growing 2 or more crops on the same piece of land during the same cropping season, is the commonest system of growing beans in Malawi especially by the small farmer who produces the bulk of the crop in the country. This system is characterised by intensive land use and maximization of scarce resources. It is not a primitive or a haphazard system as it was once thought; rather the agronomic management of crops grown in mixed stand is much more complex than that of a monocrop. Farmers over the years have realised that while the yield of a minor crop in the mixture might be reduced, the total seed yield of all crops are usually greater than when the crops had been grown in pure stand. This may explain why this cropping system is still so popular among the smallholders despite the fact that research has concentrated efforts on the growing of crops in pure rather than in mixed stands.

1. Dwarf beans

Dwarf beans can be planted on the same ridge with maize. If maize is planted on ridges which are 91cm apart and there are three maize plants per station where the stations are 91cm apart; it is possible to plant two bean rows on the same ridge as the maize. The planting population, the spacing and the arrangement is the same as described above for a pure crop of beans. Where maize has been planted on the flat, it is possible to plant beans in between the two rows of maize. Here beans should be

planted about 5-6m apart in a single row between two maize rows.

2. Climbing beans

These can also be planted on the same ridge a maize. If there are three maize plants/station, plant four to six bean seed on the same station as the maize crop. This is designed to ensure that the beans can be trained on the maize plants.

If maize are planted at one plant per station, plant two to three bean seeds on the same station as the maize plant. Again, the beans should be trained on the maize plant. You will note that we are fewer bean plants/station than would be expected. The reason is that increase plant competition and therefore reduce maize yield.

In planting either dwarf of climbing beans with maize on the same ridge, no additional fertilizer is needed for the bean crop. Both crops use the same type; and the rate of fertilizer, no additional land is required.

Also note that the bean yield when planted together with maize will be about 15-50% lower than would be expected when beans are grown as a pure crop. This should be borne in mind. However, as long as the yield of maize remains the same the bean is a bonus crop.

O. PLANTING BEANS AFTER TOBACCO

In areas where flue-cured or burley tobacco is dry planted early, it is possible to grow a crop of dwarf beans after the tobacco stems have been uprooted,provided there will be enough rainfall for a reasonable yield of a bean crop.Where the basal fertilizer has been banded for the tobacco crop, the ridges on which the tobacco were growing can be built up and beans planted as described above for a pure stand of dwarf beans.There may be no need to apply additional fertilizer.

Where fertilizer has been localized,i.e. where the fertilizer has been applied using dollop method both for the basal and the side dressing of nitrogen, then plant the beans on the same station as where the tobacco plant was.Of course, it will be necessary to loosen the soil around the station and weed the entire field before planting.In this

situation about 4-5 bean seeds can be planted per station about 45-55cm apart depending upon the type of tobacco. It should be noted, however, that there might be nematode attacking the bean crop following the tobacco crop.The degree to which the bean yield will be reduced by such a double cropping system is being investigated.

Excepting in areas where there is prolonged rainfall or where the planting is after tobacco since climbing beans take longer time to mature than the dwarf type with respect to the quality of seeds, observation have shown that higher quality seeds are produced after a tobacco crop matures under drier weather and less disease resulting from water and soil splashing on pods.

III. ON RESIDUAL MOISTURE ON IRRIGATION SCHEMES

There are about 16 irrigated settlement schemes in Malawi occupying about 4147 hectares; and there is further planned expansion of 64,000 hectares. Some of these schemes have no facilities or irrigation during the dry season and so only one crop of rice is produced. Results of trials have shown that beans can be grown on some of these schemes successfully on residual moisture. Below are tentative recommendations for growing beans as a rotational crop under residual moisture between two rice crops.

A. LAND PREPARATION

This seems to be the most crucial aspect of growing beans on residual moisture. After rice harvest, the land should be ploughed or dug up with hoe and soil clods broken into a good seedbed. The land should be allowed to "rest" for about 7-10 days before planting. At this time moisture content will not be too high for seed germination. Plant on flat.

B. VARIETIES

The varieties recommended for rain-fed crop can also be used. If planting is late, only the dwarf varieties that have a shorther growing period should be planted.

C. SEED RATE

1. Dwarf varieties

40-50 Kg/ha

2. Climbing varieties

33-45 Kg/ha

This seed rate is half what is recomended for rainfed crop because there is need to reduce competition for moisture.

D. PLANTING TIME

Plant at such a time that bean crop can be harvested before it is time to prepare land for the subsequent rice crop. Anytime from the middle of the of May to the middle of June is recommended.

E. FERTILIZER

In the absence of soil test results, the following recommendations can be used.

1. Type Used 20-20-0 or 23:21:0 (N:P2O5:K2O) Beans are poor nitrogen fixers and so may not meet their own nitrogen needs from fixation.

2. Rate 200-300 Kg/ha

3. Method of application

Band fertilizers in grooves and plant about 10cm away from the fertilizer band.

4. Time of application
Apply before or at planting.

F. PLANT POPULATION AND SPACING

1. Dwarf beans

Plant on flat with rows 45cm apart at 20cm between plants on the row. This will give about 111,000 plants/ha which is about half what is recommended for rain-fed crop. The reduction in the plant population to reduce competition for moisture.

2. Climbing beans

Plant on flat with rows 45cm apart and at 30cm between plants on the row. The population is half that which is

recommended for rain-fed crop because there is need to avoid competition for moisture.

G. DISEASE

The recommendations are as for rain-fed crop. It must be noted that the incedence of disease is very much reduced when beans are planted on residual moisture. This is probably because there is no water splashing the soil on to the plant.

H. INSECT PESTS

The most troublesome pests of beans under irrigation are aphids. Aphids can be controlled by spraying one of the following insecticides:

1. Rogor 40% EC at 1.2ml/litre of water
2. Diazinon 60% EC at 0.8ml/litre of water
3. Malathion 50% EC at 1.9ml/litre of water
4. Menazon 70% WP at 1.0g/litre of water

I. WEED CONTROL

Recommendation are as for rain -fed crop.

J. HARVEST, SHELLING AND STORAGE

Recommendation are as for rain-fed crop.

K. MIXED CROPPING

The growing of maize and beans on residual moisture is feasible provided the growing period of maize crop does not interfer[illegible] production. Where maize and beans can be grown in association, recommendations for rain-fed crop should be used.

L. SEED QUALITY

Experiments have shown that higher quality seeds are obtained from seeds produced under irrigation (residual moisture) than rain-fed crop. The difference in quality is attributed to the absence of water splashing soil and pathogen on the crop and the relatively cooler condition under which the crop is grown where disease spread is much reduced.

IV. IRRIGATED CROP

Bean crop is not irrigated in Malawi. The crop is normally grown under rain-fed condition and recently attempts have been made to grow it under residual

moisture following a rice crop. However, because of the need to diversify crop production, beans may serve as a short seasoned "wintered" rotational crop between the two rice crops. Efforts were made a few years ago to encourage small-holders to grow beans under irrigation at the British Irrigated Rice Project now Dwangwa Sugar Corporation.

Results of experiments conducted at Bunda college, Kasinthula Agricultural Research Station, Makhanga Agricultural Reseanch Station and at Domasi show promising results but water management is still a problem.

A. LAND PREPARATION

The rice crop during the normal cropping season should be ploughed or dug up with hoes about the end of April to the middle of May when the rice crop has been harvested.

Beans can be planted on ridges, beds or on flat depending on the irrigation facilities, soil type and planting technique. If flood irrigation is used, ridges should be 60-91 apart, preferably 91cm apart. Ridges closer than 60cm increase lodging problem because of erosion. If sprinkler irrigation will be used, planting can be done on flat with 45cm between rows. On medium textured beans can be grown on corrugated ridges.

B. VARIETIES

See recommended dwarf varieties under irrigation. Climbers are not recommended because of reduction of yield and quality since the pods will be resting on wet soil.

C. SEED RATE

100-120 KG/HA

The above recommendations are for the dwarf varieties listed above. The seed rate is higher under irrigation than under rain-fed condition because by increasing the seed rate, plant population can be increased to take advantage of the available moisture and hence increase seed yield.

3. Rust

Bean rust is caused by a fungus Uromyces appendiculatus. This usually infect leaves and pods and hardly stems. Symptoms white slightly raised spot. These spots later develop as brown raised pustules with a ring of yellow [illegible] round the pustules. Later the entire leaf may turn yellow, than brown and falls off from the plant. Canning bean varieties are more susceptible than most dry bean varieties.

Rust can be controlled by dusting plants at 7-10 days interval with sulphur. Daconil, Dithane M-22, Maneb, Plantvax or Manconeb can be used.

The fungus is not seed-borne so. chemical seed control has no value. Cultural control measures include the use of crop rotation and removal of infected plannt material from field, reduce infection especially during pre-flowering to flowering stages of crops development.

4. Anthracnose

This is caused by a fungus Collectotrichum lindemuthianum. The organism can infect leaves, pops and stems. Leaf symptoms are usually brown lesions along veins and veinlets which are more conspicuous on the lower than the upper leaf surface. Pods infection are sunken lesions brown to black in colour. Chemical control include the use of Du-Ter, Zineb, Maneb and benomyl. Cultural control measures include two or three years crop rotation, the removal of infected debris and the use of resistant varieties.

5. Halo Blight

see section on rain -fed crop.

1. Insects

1. cut worms

These attack the crop erratically and hence difficult to predict. Control measures include the use of baits which are applied in the late afternoon near the plant.Use bait in the mixture of:

1,000 grmmes of saw dust or maize flour
120 cc of molasses or substitute
40 grammes of trichlorfon
The above bait is also effective against crickets and millipedes.

D. TIME OF PLANTING

The crop should be planted between mid May and mid-June along the lakeshore and areas of similar weather; or even as late as the end of July in the plateau areas where temperatures are still low even at the end of July. It should be noted that canning beans are much more sensitive to low temperature than dry beans. This should be considered when deciding the time to plant the canning beans.

E. FERTILIZER

It is advisable to test soils before applying fertilizer. However, where this is not possible. General recommendations is given below.

1. TYPES

20-20-0 (N-P2O5-K2O) Plus Sulphate of Ammonia.

2. RATES

Use 300-400 kg/ha of 20-20-0 (N-P2O5-K2O) plus 150-200kg/ha of sulphate of ammonia

Higher rates are recommended for beans under irrigated than under rain-fed crop because under the latter condition the use of water is controlled with respect to timing and amount to the use and the need to exploit the availability of water in order to increase seed yield.

F. PLANT POPULATION AND SPACING

1. Ridges

Plant about 222,000 300-000 plant /ha.This is achieved by planting two rows per ridge.The top of the ridge is flattened bend in between both rows. The distance between plants is about 10cm and 7.5cm.Plant one seed per station. Fill gaps within seven days from emergence.

The planting of beans on water line is not recommeded because with flood irrigation, most of the soil erodes.The results in serious lodging problems with pods in mud and water in the furrow.

2. Flat

The same population as for ridges. However,seeds should be planted on rows 45cm apart with spacing of 3.5 to 5.0cm between plants in row. Plant one seed per station. Fill gaps (supply) within seven days after emergence.If the crop is machine planted, calibrate planter to deliver one seed every 3.5 to 5.0cm.

G. WATER MANAGEMENT

1. General aspects

Water management i.e. when and how much water to apply is one of the most important aspects of bean production under irrigation. The field where flood irrigation is used should be furrowed uniformily so that water will not stand in the furrows and they should be deep enough to prevent flooding and to keep pods out of the water. The bean plant is relatively shallow-rooted and has an effective depth of water withdrawal of about 91cm. It is, therefore, essential that planting should start with a full moisture profile.

Two to three days before planting, fields should be irrigated with about 100mm of water. This is known as "pre-planting irrigation". This is to ensure that there is to not too much water around the seed at planting and seeding emergence as beans cannot withstand "wet feet". The first irrigation after the pre-planting one should be applied before the plants are under moisture stress.Too liberal and frequent irrigation result in excessive vegetative growth and yield reduction.Proper irrigation management, therefore, is to irrigate infrequently.

2. Amount frequency

The number of irrigations and the amount of water needed at each irrigation depend partly on the season, and the type and depth of soil and partly on the amount of organic matter in the soil and the slope of the land. It has been shown that the ratio of evapotranspiration to open-pan evaporation (Et/Eo) over the life of the crop is 0.72 with an Et/Eo ratio of 0.91 about three weeks from planting which coincides with the period of maximum ground cover. Where evaporation pan is available, irrigation frequency and rate should be based on Et/Eo factors.

In the absence of information on the consumptive water use, it is recommended to irrigate four times in addition to the pre-planting irrigation of 100mm with 50-65mm each time as follows:

Pre-planting,
Two to three weeks after planting,
Begining of flowering or just before flowring,
Begining of pod filling, and
Begining of pod maturation.

The pre-planting irrigation is to ensure that the plant starts with a full moisture profile for rapid and uniform emergence. Irrigation at two to three weeks after planting is for adequete development before flowering. Irrigation at the begining of flowering or just before flowering increases the number of pods/plant. A good supply of water at the beginning of of pod fill increases the number of seeds/pod and seed weight. The last irrigation is intended to hasten the filling and maturity of the last pods that were set.

Excessive applications waste water and in some places may cause excessive vegetative growth, production of secondary set of flowers that may produce very small or sometimes seedless pods delay maturity and reduce seed yield. At each irrigation time, water should be allowed to run only as long as is necessary to wet the soil to capacity in yhe root zone. In fields of long ridges and where there is not much slope crops ridges should be made at convinient intervals.Otherwise the upper end is likely to be flooded before the lower end is wet enough.

3. Time of irrigation

a. Flood irrigation

No definite time. Irrigation can be done to fit with normal farm operations. However, irrigating too early in the morning or too late in the evening will lower soil temperature which could slow the rate of crop's growth and developement. Higher seed quality are produced underfllod than sprinkler because of the spread of disease spread with the latter.

b. Sprinkler irrigation

The use of sprinkler irrigation has been reported to increase the spread of diseases by droplet splash. One alternative of overcoming the problem of

disease spread resulting from the use of sprinkler is to irrigate at night if this can be fitted into the normal farming operation. Leaves are normally wet at night from dew and once the leaves are allowed to dry during the day, the risk of disease spread can be reduced. Irrigation at night might seem to contradict the reason for not irrigating early in the morning or late in the evening in the case of flood irrigation. The time of sprinkler irrigation is based, therefore, on a choice between disease spread and reduce growth rate which may prolong the duration of crop's growth without necessarily causing reduction in seed yield and quality.

H. DISEASES

1. Rhizoctonia root rot

1. Rhizoctonia root rot is caused by a fungus Rhizoctonia solani. The symptoms of the disease are red lesions on the lower part of the stem and the roots. The plant becomes chlorotic and stunted. The pathogen can be transmitted thro..gh irrigation water, aerially disseminated sclerotia or spores, and infected seeds. The fungus may be internally or externally seed borne.Control measures include the use of fungicides such as benomyl, thiram, zineb, captan, vitavax or busan. The use of cultural control measures include crop rotation by planting beans after maize, wheat or oats. Avoidance of excessive moisture can also reduce infection and spread.

2. Southern blight

Southern blight also know as crow root or sclerotium root rot is caused by a fungus Sclerotium rolfsii. Plant symptoms appear as dark-brown water soaked lessions on the stem or hypocotyl just below the soil line. Foliage symptoms consist of yellowing of leaves and defoliation in the upper branch leaves. Pods that touch soil may become infected and rot.

Control with chemicals include the use of PCNB (pentachloronitrobenzene) difolatan 4F, or Captafol. Cultural practices that can reduce southern blight include the use of disease resistant varieties, wide plant spacing or to follow maize or sorghum with beans.

2. Bean fly

Bean fly or bean stem maggot is caused by three species of Ophiomyia. This is the major pest of beans in Malawi and heavy infestation can result in complete loss of the crop.

Damage by bean fly is caused by the larvae which tunnel within the plant tissue.This begins in the leaves then extends down the mid rub and into the stem. The larvae pupate on the stem at ground level with black to brown colour cigar-shaped pupae. These invade the vascular bundle and causing demage which restrict nutrient and photosynthate translocation.Susceptible plant's leaves turn yellow and plant dies, resistant plants produce aerial roots above the would.Chemical control methods include the use of aidrin 40% WP at the rate of 28 grammes of commercial product per 405 Kilogrammes of seed as dust.

3.Wire grubs

These are a problem especially if beans are grown after a pasture crop.

Chemical control include the use of Carbofuran. land preparation is a cultural control method.

J. ENVIRONMENTAL DISORDES

1. LOW TEMPERATURE

Beans, especially canning bean varieties, are rather sensitive to low soil temperatures (10-15C).Leaves of susceptible seedlings turn yellow and fall off before the first trifoliate leaves emerge.

Susceptible cultivars should be planted when the soil temperature is higher than 15C.

2. SUN SCALD

Sun scald or light injury may affect leaves,stems or pods.This condition is caused by intense by heat followed by high humidty and cloudy weather. There also appear to be some association with heavy application of fertilizer.

Affected plant parts show lesions which can be mistaken for bacterial blight. But such lesions have no bacterial exudates. There are no resistant varieties.