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PRELIMINARY STUDIES ON YAM AND YAM-BASED CROPPING SYSTEMS IN ST. LUCIA

M. M. Rao and C. George

CARDI
P.O. Box 971
Castries, St. Lucia, W.I.

ABSTRACT

Three field experiments, two at Field Stations and one on farmers' holdings, were conducted on yam and yam-based cropping systems in St. Lucia during 1985-86.

A comparison of five cultivars of white yam (Yam Langie, Local White, Oriental Yam, Belep and Knnabayo) at the La Ressource Field Station, showed that Oriental Yam yielded significantly higher than the other cultivars both on a cycle-basis (39.8 t/ha) and on a day-basis (208 kg $ha^{-1}day^{-1}$), and also showed a high degree of tolerance to anthracnose.

Intercropping of yam with cowpeas, snapbeans and dasheen at the Union Agricultural Station, or relay intercropping of yam wi*h cowpeas and snapbeans on farmers' holdings in the southwest did not significantly lower the yields, or affect yield attributes of yam as compared to the sole crop. At Union, the different cropping systems did not delay the incidence nor reduce the severity of anthracnose on yam.

INTRODUCTION

Yams (**Diosccorea** spp.) are among the major root crops grown extensively for local consumption and for regional and extra-regional markets. The most commonly grown yam species are **D. alata, D. rotundata, D. cayenensis** and **D. trifida**, but there is no specialized system of production of any of these species in the Island. Average yields are relatively low (0.5 t/ha), mainly due to a lack of high yielding, disease tolerant cultivars, and traditional crop management practices. In recent years, the production of white yam (**D. alata**) has been reduced by frequent epidemics of anthracnose.

The systems of yam culture in St. Lucia incude both sole cropping and mixed relay cropping. The latter has evolved through practice and experience by the peasant farmer as an answer to the vagaries imposed by his environment. There is now evidence to indicate that mixed and relay cropping give more effective utilization of the land than sole cropping. Gains over sole cropping have been attributed to better light and nutrient utilization because of different canopy structures and nutritional requirements of the components of the mixtures.

Lyonga (1981) observed that in Cameroon yam yields were reduced by 50% when intercropped with maize at a population of 50,000 plants ha^{-1}. He attributed this reduction to the shading by maize retarding leaf formation. However, he found that yams could combine well with groundnuts even at a population of 200,000 groundnut plants ha^{-1}. Wahab et al. (1985), working at the Allsides project in Jamaica, reported that onions, corn, pumpkin, cabbage, carrot, cassava and sweet potato performed poorly as intercrops in yam. From Nigeria, Odurukwe (1986) reported that intercropping of yam with maize at 33,000 plants ha^{-1} reduced tuber yields (29% and tuber size (20%), but improved land equivalent ratios LER (66%).

Although there is increasing evidence to show that some intercrops are more compatible than others, there is a dearth of information to indicate the effect of these intercrops on the incidence of anthracnose. Moreover, studies on the effect of relay intercropping with different legumes in yams are altogether lacking.

The objectives of these experiments were therefore:

1. To evaluate the performacne of different cultivars of white yam (**D. alata**) for yield and tolerance to anthracnose;

2. To study the effect of intercropping on yield and yield attributes, and the incidence of anthracnose in yam; and

3. To assess the effect of relay intercropping of different legumes on yield and yield attributes of yams.

MATERIALS AND METHODS

Experiment 1

This was conducted at the CARDI Field Station, La Ressource, St. Lucia. Information on the soils and their chemical properties at the experimental site is presented in Table 1. The experiment was laid out in a randomized complete block design with five treatments (cultivars) and four replications. The cultivars of white yam (**D. alata**) evaluated were (i) Yam Langie, (ii) Local Whtie; (iii) Oriental Yam; (iv) Belep and (v) Kinabayo. The first two cultivars are grown extensively in St. lucia. Oriental Yam was introduced from Barbados in 1984-85 and found to be high yielding and to show a high degree of tolerance to anthracnose. The last two cultivars were introduced from INRA, Guadeloupe. Yam pieces of about 100 g were planted on June 24, 1985 on ridges at a spacing of 1.0 x 1.0 m and drenched with a solution of Benlate and Vydate L. Each plot has 55 plants. Net plot size was 27 m^2. The vines were supported on wooden stakes 2.0-2.5 m long, and 2.4-4.0 cm diameter, from six weeks onwards. Each plot was given 32 g of 16-8-24 NPK fertilizer at about 8 weeks. Weeds were controlled by hand weeding and regular sprays of Gramoxone or Round-up. The incidence of anthracnose was monitored throughout the crop cycle and the disease was assessed on 0 to 5 point scale (none; 0-10%; 11-25%; 26-50%; 50-75%; and > 75%). Oriental Yam, Belep and Kinabayo were harvested on January 2, 1986; Yam Langie and Local White, on February 25, 1986.

Table 1. Soil groups and chemical properties of the experimental sites

Experiment	Soil Order	pH	Electrical conductivity (μ mhos/cm)	Truog P (ppm)	Exchangeable Mn (ppm)	Exchangeable cations (m.e./100 g of soil)		
						K	Ca	Mg
1	Vertisol	5.0	55	296	22	1.8	16.9	2.66
2	Vertisol	5.6	55	35	70	1.2	12.0	12.00
3	Mollisol	5.2	162	2.2	8	1.5	5.0	1.64

Experiment 2

This experiment was carried out at the Union Agricultural Station of the Ministry of Agriculture, St. Lucai. The soil order and data on chemical properties at the experimental site are presented in Table 1. The experiment was laid out in a randomized complete block design with nine treatments and three replications. The treatment details are given in Table 2. Seed pieces (about 100 g) of white yam cv. Yam Langie, and the

Table 2. Treatment details of Experiment 2, showing planting pattern crop densities

Treatments	Symbols and planting pattern[1/]	Plant population ('000) ha				
		Y	C	S	D	Total
Sole yam	Y	10	--	--	--	10
Yam + cowpeas	Y-C-Y-C	10	10	--	--	20
Yam + cowpeas	Y---Y-2C	10	10	--	--	20
Yam + snapbeans	Y-S-Y-S	10	--	10	--	20
Yam + snapbeans	Y---Y-2S	10	--	10	--	20
Yam + dasheen	Y-D-Y-D	10	--	--	10	20
Yam + dasheen	Y---Y-D	10	--	--	5	15
Yam 1 dasheen + cowpeas	Y-D-Y-2C	10	10	--	5	25
Yam + dasheen + snapbeans	Y-D-Y-2S	10	--	10	5	25

1/ Y = yam; C = cowpeas; S = snapbeans; D = dasheen.

intercrops were planted on July 8 and 30, 1985, respectively. Yams were planted at a spacing of 1.0 x 1.0 m. Crop management practices and the anthracnose disease rating scheme were similar to those of Experiment 1. Dasheen was the only intercrop which received fertilizer at 16.0 g/plant of 16-8-24 NPK mixture at 45 days after planting. The varieties of intercrops and their durations are presented in Table 3. Both cowpeas and snapbeans were grown for green salad beans. Yamw were harvested on February 20, 1986 with a net plot size of 18.0 m^2.

Table 3. Varieties of intercrops and their duration in Experiment 2

Intercrops	Variety	Date of Planting	Date of Harvesting	Duration
Cowpeas	Blue Sitao #1	30/7/85	25/10/85	86
Snapbeans	Blue Lake (Stringless)	30/7/85	11/11/85	103
Dasheen	Local	30/7/85	12/02/86	196

Experiment 3

This trial was conducted on farmers' holdings in the southwestern parts of St. Lucia. Information onthe soil and its chemical properties at the experimental site is presented in Table 1. The experiment was laid out in a randomized complete block design with one replication per farm and six farmers were involved.

The following treatments were investigated:

1. Sole Yam (no intercropping)
2. Yam + snapbean
3. Yam + snapbean --> cowpeas
4. Yam + cowpeas
5. Yam + cowpeas --> cowpeas

White yam cv. Oriental was planted on mounds at a spacing of 1.0 x 1.0 m on April 22, 1985. Yams were staked and fertilized (as in Experiment 1). The first set of legumes was planted three weeks after the yams around the mound about 30 cm away from the seed piece. The density of intercrops was maintained at 50,000 plants per hectare (5 plants/mound). Details of the intercrops and their durations are given in Table 4. The yams were harvested on December 10, 1985 and the net plot size was 21.0 m^2. With both cowpeas and snapbeans, the green pods were harvested as salad beans.

Table 4. Details of intercrops and their duration in Experiment 3

Item	Cowpeas 1/		Snapbeans 2/	
	Crop 1	Crop 2	Crop 1	Crop 2
Date of planting	10/05/85	31/07/85	10/05/85	31/07/85
Date of harvest	31/07/85	03/10/85	04/07/85	04/11/85
Crop duration (days)	82	64	55	96

1/ Cowpeas cv. Bush Sitao #1
2/ Snapbeans cv. Blue lake (Bush Type) - Crop 1
Blue Lake (Stringless) - Crop 2

RESULTS AND DISCUSSION

Experiment 1

Total tuber yield and other yield attributes, except average tuber weight, were significantly different (Table 5). Oriental Yam gave the highest yield (39.7 t/ha). This superiority can be attributed to faster germination and early growth, more tubers per plant and a greater tolerance to anthracnose.

The two local cultivars, i.e., Yam Langie and Local White, matured about two months later than the other cultivars. Consequently, the efficiency of tuber production, calculated on a kg/ha/day basis shows that the local cultivars are significantly inferior in efficiency of tuber production than the others. This is possibly due among other factors, to slower germination, slower growth and a greater susceptibility to anthracnose.

The number of tubers per plant was significantly higher (3.51/plant) in Oriental Yam than in the others, but the differences in this character between Kinabayo, Belep and Local White were nonsignificant: Yam Langie had the lowest number of tubers per plant (1.16).

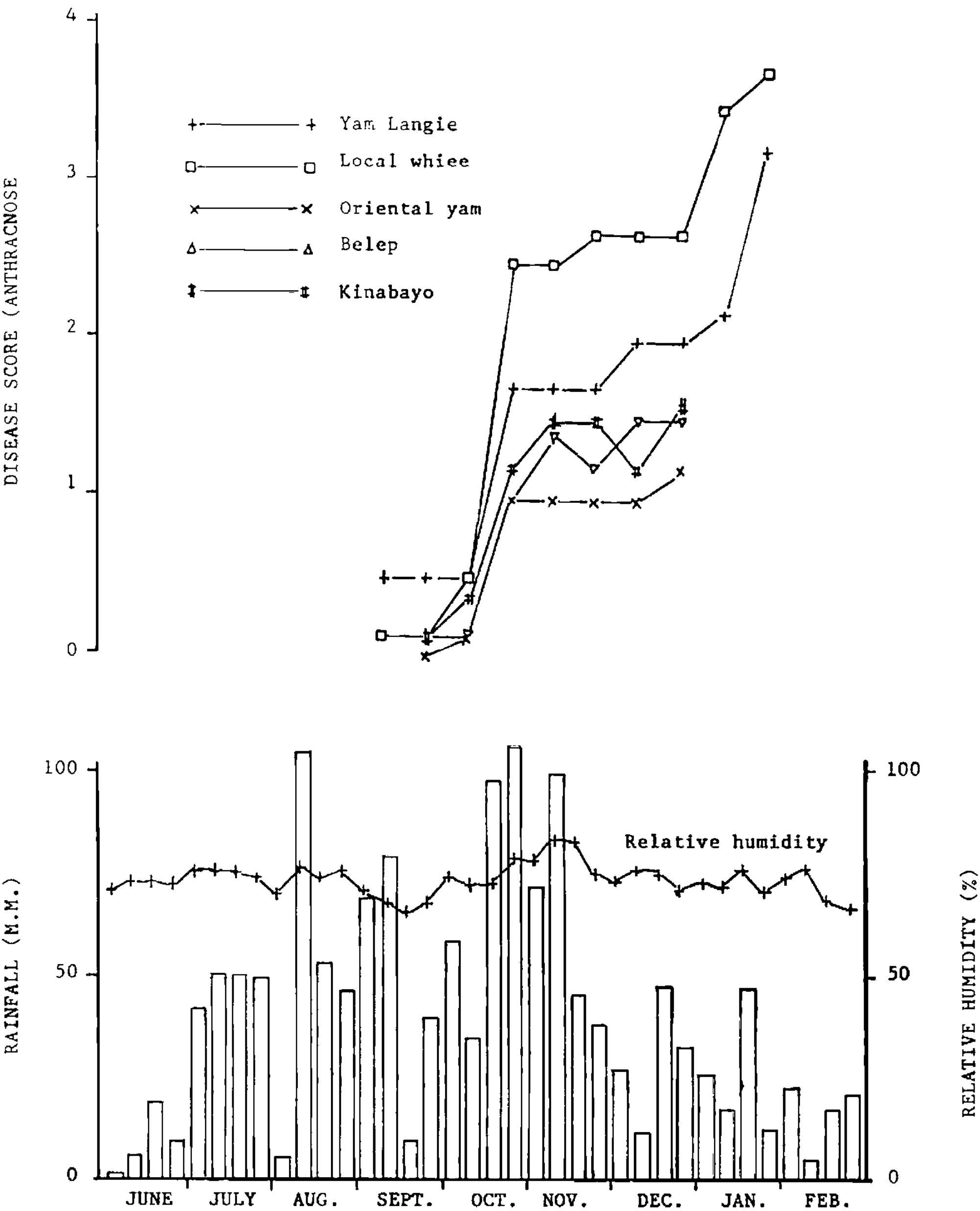
Table 5. Yield and yield attributes of different cultivars of **D. alata** (Experiment 1)

Cultivars	Total tuber yield (t/ha)	Efficiency of tuber production (kg/ha/day)	No. of tubers/ plant	Mean tuber wt. (kg)	Per cent germination at 30 DAP1/
Yam Langie (control)	20.7	83.5	1.16	1.78	79.5
Local White (control)	20.5	83.0	1.63	1.58	84.1
Oriental Yam	39.8	208.0	3.51	1.14	100.0
Belep	22.3	117.0	1.56	1.33	97.7
Kinabayo	25.8	135.0	1.87	1.44	90.0
S.E.(d)	3.9	21.5	0.32	0.29	6.2
L.S.D. (P=0.05)	8.6	47.0	0.69	--	13.6
C.V. (%)	21.7	24.0	23.00	28.30	9.7

1/ DAP = Days after planting.

Symptoms of anthracnose appeared in all the cultivars about three months after planting (Fig. 1). Disease intensity increased with more rain and higher humidity sometime in October and it more or less stabilized in the next two months. Nevertheless, the disease occured earlier and was more severe throughout the growing season in the local cultivars, i.e., Yam Langie and Local Whtie, than in the others. At harvest time, more than 50% of the foliage was affected with the disease in the local controls, but in Oriental Yam, Belep and Kinabayo, the disease score was substantially lower.

Fig. 1. Weekly rainfall (June 1985-February 1986), relative humidity and incidence of anthracnose in different cultivars of white yam (Experiment 1).



Experiment 2

Cowpeas were grown in three cropping systems and the yield of cowpeas in Y-C-Y-C was higher (2.29 t/ha) than in either Y---Y-2C (1.45 t/ha) or in Y-D-Y-2C (1.62 t/ha), but these differences were not significant (Table 6). The coefficient of variation was high (37.3%). The yield of cowpeas was better than that of snapbeans, possibly due to the type of snapbean cultivar used (pole type). The yam vine may have suppressed the yield of snapbeans since both of them were trailing on the same stake.

The yield of snapbeans in Y-S-Y-S was higher (1.35 t/ha) than the yield in either Y---Y-2S (0.97 t/ha) or in Y-D-Y-2S (0.44 t/ha), but these differences were not significant (Table 6).

Table 6. Yield of intercrops in Experiment 2

Treatments	Yield of intercrop, (t/ha)		
	Cowpeas	Snapbeans	Dasheen
Y-C-Y-C	2.29		
Y---Y-2C	1.45		
Y-S-Y-S		1.35	
Y---Y-2S		0.97	
Y-D-Y-D			4.42
Y---Y-D			1.83
Y-D-Y-2C	1.62		1.75
Y-D-Y-2S		0.44	2.67
S.E.9d)	0.54	0.44	0.55
L.S.D. (P=0.05)	--	--	1.22
C.V. (%)	37.3	59.5	22.90

Dasheen was grown in four cropping systems at two different plant populations, i.e., 5,000 or 10,000 plants per hectare. The yield of dasheen at the higher density (Y-D-Y-D) was significantly greater (4.42 t/ha) than the yield at the lower density (Y---Y-D, Y-D-Y-2C, Y-D-Y-2S) (Table 6).

Intercropping of yam with the different food crops did not significantly affect yield or yield components of yam (Table 7). Lack of harmful effects of intercrops on yam can perhaps be attributed to their low densities. Intercropping yam with cowpeas lowered tuber yield by between 1.0 and 2.5 t/ha whereas snapbeans increased it marginally, in spite of the fact that the variety of snapbeans used was a pole type and took longer to harvest (103 days). Inclusion of dasheen in the crop-mix at either 5,000 or 10,000 plants per hectare did not depress tuber yield significantly as compared to the sole crop.

The number of tubers per plant varied from 1.11 to 1.88 and the average tuber weight ranged form 1.23 to 1.89 kg, but these differences were non-significant.

The different polyculture systems did not delay the incidence or reduce the severity of anthracnose significantly as compared to the pure stand

(Figure 2). At this location, in general, the disease appeared relatively late in the season due to well distributed rains and low humidity. Disease intensity progressed more or less uniformly in all treatments with time, but, at harvest time, the disease score was higher in yams associated with food crops than in the pure stand. The lack of any effect of intercropping on the intensity of the disease may be attributed to the nature of the intercrops. In addition, the disease incidence started rather late, by which time some of the intercrops were already harvested (cowpeas and snapbeans).

Table 7. Yield and yield components of yam as affected by different cropping systems in Experiment 2

Cropping systems	Yield (t/ha)	No. of tubers per plant	Mean tuber weight (kg)
Y	16.3	1.53	1.50
Y-C-Y-C	13.7	1.19	1.31
Y---Y-2C	15.2	1.45	1.23
Y-S-Y-S	21.7	1.88	1.50
Y---Y-2S	16.7	1.20	1.89
Y-D-Y-D	16.3	1.15	1.76
Y---Y-D	20.5	1.42	1.71
Y-D-Y-C	15.0	1.11	1.78
Y-D-Y-S	15.5	1.42	1.51
S.E. (d)	4.0	0.24	0.29
L.S.D. (P=0.05)	--	--	--
C.V. (%)	29.0	21.60	22.8

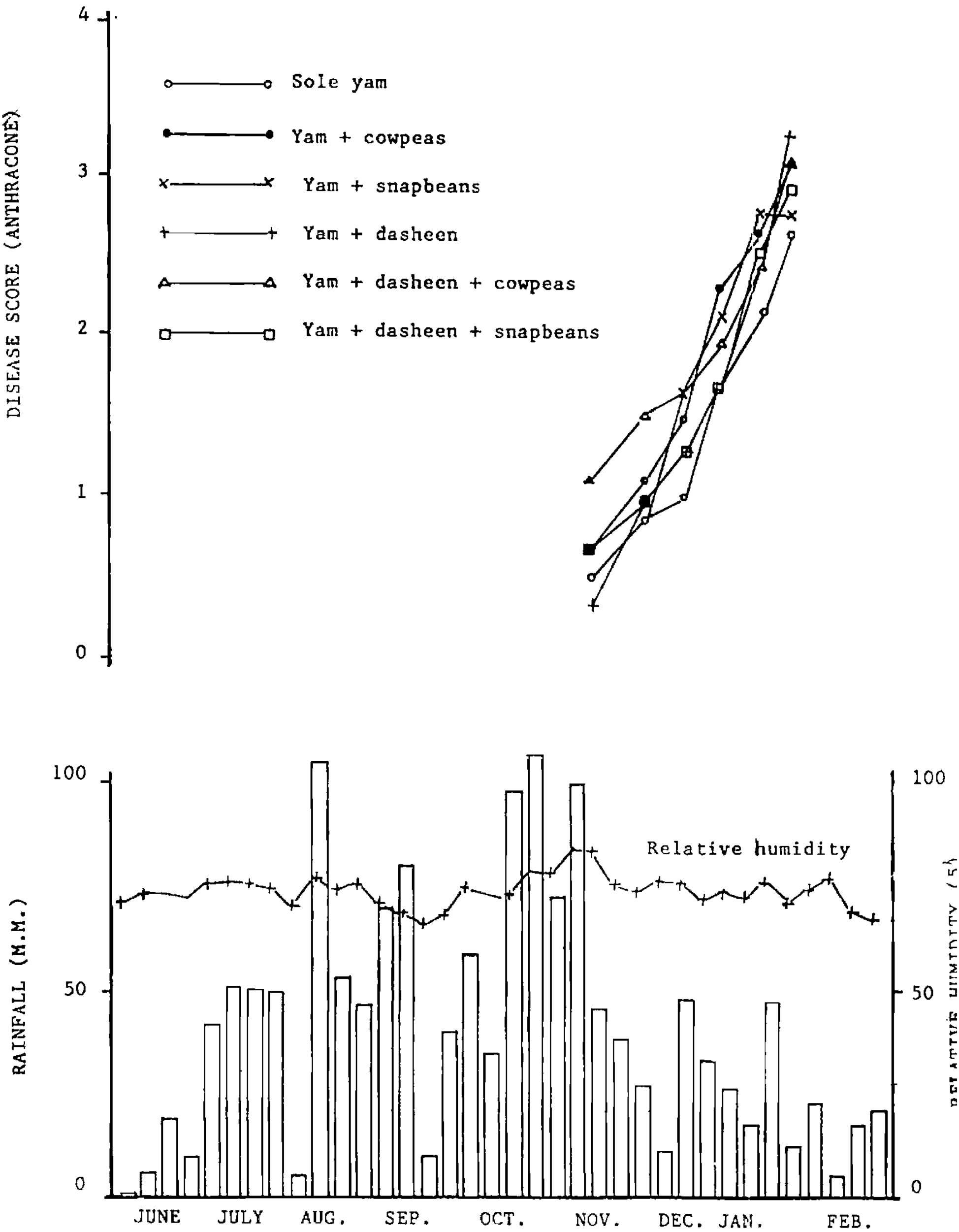
Experiment 3

Snapbeans performed better than cowpeas both in the first and second plantings. The second crop of each of these legumes yielded lower than the first crop, probable due to shading effects (Table 8). The yield advantage in planting a second crop of snapbeans and cowpeas was 700 kg/ha and 227 kg/ha, respectively. These yields represent only 39% and 27% of the yield obtained inthe first planting. From this, it was apparent that snapbeans can tolerate competition pressure better than cowpeas.

Table 8. Yield of intercrops in different treatments in Experiment 3

Treatments	Bean Yield (kg/ha)		
	Crop I	Crop II	Total
Sole Yam	-		-
Yam + Snapbean	1801 + 636		1801
Yam + Snapbean ---Snapbean	1674 + 700	704 + 370	2378
Yam + Cowpeas	853 + 306	-	853
Yam + Cowpeas --- Cowpeas	932 + 408	227 + 139	1159

Fig. 2. Weekly rainfall (June 1985-February 1986) relative humidity and incidence of anthracnose on yam in different yam-based cropping systems (Experiment 2)



Relay intercropping reduced the yield of yam, but not significantly (Table 9). This reduction varied from 3% in yam relay intercropped with snapbean to 24% in yam + cowpeas. On average, the yield of yam was slightly lower (by 1.72 t/ha) when intercropped with cowpeas than with snapbeans. Yield attributes, i.e., number of tubers per plant and the average tuber weight were also unaffected by treatments (Table 9).

Table 9. Yield and yield attributes of white yam as affected by different treatments in Experiment 3

Treatments	Tuber yield (t/ha)	Per cent relative to sole yam	No. of tubers/ plant	Av. tuber wt. (kg)
Sole yam	12.6	-	1.14	1.16
Yam + Snapbean	11.3	89	1.39	1.07
Yam + Snapbean --- Snapbean	12.3	97	1.31	1.16
Yam + Cowpeas	9.6	76	1.26	1.06
Yam + Cowpeas --- Cowpeas	10.5	83	1.23	1.10
S.E. (d)	1.5	-	0.12	0.15
L.S.D. (P=0.05)	-	-	-	-
C.V. (%)	23.5	-	15.1	23.3

The results discussed above are based on one year's data only, and further research is needed to validate them.

In selecting the treatments for further testing and refinement, criteria such as ease of management, nutritional value of the outputs and economic benefits will be used.

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