INTEGRATION OF YAM INTO A CONTINUOUS FARMING SYSTEM IN DAHOMEY

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SUMMARY

Although it is technically possible to integrate yam production into continuous rotations with a sufficient level of fertilizer use, this creates particular secondary problems for yam production. These are intense weed competition, which yams are badly adapted to meeting, and the build up of populations of yam root nematodes. As an intermediate practice between shifting cultivation (or long natural fallows in settled farming) the use of planted grass fallow of *Andropogon gayanus* is a practicable alternative but one which, without the use of fertilizers, must be expected to continue a slow downward trend of fertility, and require increased land holdings per family to maintain food production.

RESUME

Bien qu'il soit techniquement possible d'intégrer la production de L'igname dans des rotations permanentes en maintenant un niveau suffisant d'engrais, cela crée des problèmes secondaires particuliers á la production de l'igname. Ce sont d'une part, la compétition active des mauvaises herbes que l'igname n'arrive point à supporter, et la formation de populations de nématodes d'igname d l'autre. Une pratique intermédiaire entre la culture itinérante (ou de longues jachères naturelles en culture permanente) consisterait à utiliser l'*Andropogon gayanus* comme jachère, ce qui représente une voie pratique possible, mais qui, faute d'engrais, renforcera la tendance à la baisse de la fertilité et nécessitera que chaque famille augmente les superficies qu'elle cultive pour maintenir la production alimentaire.

RESUMEN

Aunque técnicamente es posible integrar la producción de ñame a una rotación continua, con el uso adecuado de fertilizantes, se crean problemas secundarios particulares para la producción de este cultivo. Tales problemas son: competencia acentuada de malas hierbas, para lo cual el ñame esta poco adaptado, y el crecimiento de poblaciones de nematodos de la raíz del ñame. Como una práctica intermedia entre la agricultura nómada (o empleo de descansos largos del terreno en la agricultura sedentaria) el establecimiento del pasto *Andropogon gayanus* (para el período de descanso) es una alternativa práctica en la cual, sin embargo, puede esperarse un continuo descenso de la fertilidad del terreno si no se usan fertilizantes; requiere por otra parte que la tierra que detenta cada familia se incremente, para mantener la producción de alimentos.

INTRODUCTION

Shifting cultivation occurs side by side with cotton farming in northern Dahomey. Cotton farming, which can be integrated into settled farming based on a variety of crops has made great strides recently, but yam cultivation is a major obstacle. Yam farming methods are highly traditional and there are also many technical problems. This paper reports attempts by IRAT to integrate yam production into a modern production system.

SOIL: PHYSICAL PROBLEMS

Farming without very great care toward this rapidly reduces the organic matter content of the soil leading to degradation of its structural characteristics, especially porosity.

Yam cultivation is not well suited to compacted soils. The harmatten winds, starting immediately after the normal time of ridging for yams in March-April, and with alternate moistening by the early rains and dessication due to the wind and high temperatures, accelerate soil deterioration. Soil compaction seems to have at least two serious adverse effects on yam growth. It increases heat conduction considerably, which causes an increased risk of rotting of the setts, and also causes considerable resistance to shoot emergence.

For continuous yam cultivation it is necessary either to work out farming practices to overcome the drawbacks associated with physical degradation of the soil, or develop a method that will periodically

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renew good soil structure. At present a solution to the first problem seems to be to delay ridging and planting until the start of the rains. This seems also to be useful for the control of yam nematodes. The traditional periodical long fallow, or the use of an artificial fallow, is undoubtedly the easiest way to manage the soil for yam cultivation. The benefits of artificial fallow extend also to other crops and can therefore be regarded as a definite advantage for stable farming systems including yams.

CHEMICAL FERTILITY

Many fertilizer trials in northern Dahomey over the past 10 years have shown a positive response to mineral fertilizers, but some depressive effects have been often reported, especially from the use of nitrogen. Although organic manuring has given positive responses, the generally low responses obtained do not justify, on economic ground, the use of this type of fertilizer in preference to leaving the land fallow. However, it has to be admitted that the number of experiments on these subjects has been very limited and it is necessary to conduct further studies.

With adequate use however of chemical fertilizers it seems clear that a continuous farming system can return a profit and maintain fertility at a level high enough to produce good yam yields within a rotation of crops.

ADAPTATION OF FARMING PRACTICES

In an area where yam is the staple food, the successful integration of this crop into a continuous cropping system depends on assuring the farmer that he can get at least the same advantages as he can with the traditional system by employing the necessary inputs. Three requirements are essential to him: increased production of *D. rotundata*; large size of tubers; high overall production. Experimentation has shown that modifications in farming practices can to a large extent already achieve these objectives.

Reduction of plant density by increasing the size of ridges can considerably improve production per ridge, but, of course, yields per unit of land are consequently lower. If fertility conditions have not been extremely degraded, the reduction in plant density can usually be offset by increasing the area cultivated. With an increase in area proportionally less than the decrease in plant density, the farmer can still produce tubers of normal size and maintain production to meet his needs.

The efficiency of trellising in yam production is well known, but because of the amount of work involved it is not used in the traditional system. Experiments have shown that *Dioscorea rotundata* cultivars respond best to trellising and that the operation proves relatively more efficient with the second crop.

In practice, these results have two applications: By speeding the growth of tubers, trellising can be used to correct the consequences of less favourable fertility conditions as far as early growth is concerned. Thus, this method can be justified primarily for use with relay cropping. By speeding the development of shoot growth trellising helps to increase yield by extending the first harvest.

The weight of the setts used for planting has a considerable influence on early growth. Although planting heavier setts is expensive and results cannot be generalized, this practice can be combined with trellising to enhance early crop production or to compensate for a delay in sowing.

THE PROBLEM OF WEEDS IN CONTINUOUS CROPPING SYSTEMS

In stable farming sytems, the general use of fertilizers, particularly nitrogen, results in proliferation of weeds which are difficult to control in yam farming. Studies have shown that the amount of care needed to produce yams in a continuous farming system without fallows amounts to 70—100 days' work compared to 30—40 days in the traditional system.

Many African farmers are extremely sensitive to the weeding requirement, and one of the essential conditions needed before he will accept any modification to his traditional farming methods is the inclusion of a provision for effective weed control so that the new system will not involve extra work. The few experiments on herbicides conducted in Dahomey over many years have not yet generated much interest in chemical weed control in yam husbandry.

Yams are rather uncompetitive, even when well established and hence a single herbicide treatment to control early weeds is not sufficient. Experimentation has shown that an efficient and less expensive solution than that involving herbicides can be reached with occasional recourse to artificial fallow.

Since 1966 IRAT, Dahomey, has studied artificial fallows. A method has been worked out and is now ready for extension. *Andropogon gayanus* has been selected as the species best suited for artificial fallow. It establishes well if sown under sorghum, completing the rotation with no adverse effects on the cereal: it resists fire: it can be sown easily and seed is readily available. Introduced at the end of the farming cycle,

Andropogon gayanus takes advantage of residual fertility, develops quickly and spreads over the soil when the first rainy season comes. With the exception of *Imperata cylindrica* weeds are totally eliminated after three years, and when it is time to farm again, the soil is cleaner than with the traditional system and there is no regeneration of woody species.

PROBLEMS OF NEMATODES

When yam is grown other than on newly cleared land, it tends to become quickly invaded by nematode parasites which reduce yields considerably by slowing its growth (by rotting of plant roots) and generally weakening the crop.

Fallow effectively eliminates yam nematodes. When inexpensive, easy-to-use nematicides are not available, the only solution proposed at the present time is to leave planting until the first rains come in order to put into the ground only good setts which have started sprouting. Such a solution has two important disadvantages however. First, it reduces yields, and second, it implies the need for new cultivars with storage characteristics different from those of present ones.

CONCLUSIONS

Data collected in experiments have identified two possible alternative ways to integrate yams into settled farming systems.

(a) By a continuous farming system with a relatively high fertilizer input which provides yams with excellent conditions of chemical fertility but which presents problems with physical fertility, weed competition and parasitic nematodes.

(b) By a farming system including an artificial grass fallow to eliminate, or at least considerably reduce, problems associated with continuous cropping.

At the present stage of agricultural development in northern Dahomey where, on the one hand the farmer seems to be unable to make proper use of land and protect it from fires, and on the other hand, fertilizer use has so far proved unsuccessful, it is obvious that the prime disadvantage of not intervening to change the system is the declining fertility which will otherwise continue.

In northern Dahomey it appears technically possible to achieve acceptable yam production in the framework of a permanent farming system based on discontinuous cultivation.

(a) Considering that land is readily available in that area and that population pressure is low, occasional recourse to fallow seems acceptable.

(b) The techniques for artificial fallow are now established and can be extended without much difficulty.

(c) Modifications worked out in farming methods can largely help compensate for soil fertility degradation inevitable for the moment. These include:
   - trellising: limited to rainy season varieties, it does not impose a considerable increase of work.
   - reducing plant population: this alternative is possible within a stable and continuous system of cultivation. Under present conditions land used for yam cultivation is less than half that used for cereals and cotton. Integrating all of these crops into a single production system should, by doubling the land use per rotation, allow the farmer more freedom to reduce plant population and to maintain production at usual levels of quality and quantity. The necessity to cultivate more acres of land would be compensated by little or no land clearing and the possibility of carrying out plough tillage.

TABLE 1

Influence of planting density on the yield per ridge and on yields/ha.

Cultivar	Spacing (m)	Ridges/ ha	%	Yield/ ridge	%	Yield t/ha	%
Terkokonou	1.2 x 1.2	6945	100	2.49	100	17.29	100
	1.6 x 1.6	3906	56	3.68	148	14.37	83
	2.4 x 2.4	1736	25	5.71	229	9.91	57
Singou	1.2 x 1.2	6945	100	1.950	100	13.54	100
	1.6 x 1.6	3906	56	2.500	128	9.76	72
	2.4 x 2.4	1736	25	4.500	230	7.81	58

TABLE 2

Influence of trellising on production of species of yams

Species		No trellising	Trellising	%
D. cayenensis cv. Terkokonou		16.780 kg	24.950 kg	+ 46
D. rotundata cv. Agogo	1st harvest	8.315	15.400	+ 85
	2nd harvest	2.590	7.920	+206
	Total yield	10.905	23.320	+113

TABLE 3

Influence of the weight of the cutting on production in terms of two periods of planting

Date of planting	Weight of setts 0.5 kg	1.00 kg	Increase of yield to setts of 1 kg.
10 March 1972	19.00 t/ha	24.1 t/ha	+ 5.1 t/ha
10 May 1972	11.4	17.3	+ 5.9
Effect of early planting	+7.6	+6.8	