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COST OF PRODUCTION OF VEGETABLES PRODUCED WITH HYDROPONIC SAND CULTURE: TOMATOES, LETTUCES, CUCUMBERS

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INTRODUCTION

Hydroponic sand culture was developed a few years ago in French Guyana for vegetable species such as tomatoes, lettuces and cucumbers. This technique was utilized to solve technical problems due to some adverse conditions such as poor leached soils, lack of available organic matters, soil born diseases, etc. Commercial hydroponic is now practiced successfully by growers on areas of about 200 m2 (600 sq. ft.) and also on larger scale from 1,000 m2 (3,281 sq. ft.) up to 6,000 m2 (1.5 acre).

Research was recently undertaken with the purpose of improving the technique of production in consideration of the economical aspect.

The following points were considered: 1. Production of higher yield of first commercial quality. 2. Precocity of the crop. 3. Labor saving, to allow a grower to manage a larger area. 4. Security, given by a better pest control, mainly on the soil born pests. 5. A reduction of the expenses on inveatments and management for a lower cost of production.

This last point will be specially considered here, its influence is direct on the cost of the vegetable production under sand culture.

TWO METHODS OF SAND CULTURE: CAPILLARITY AND TRICKLE IRRIGATION

The sand culture method developed first had the following characteristics: a concrete cultivation tank with a 1 to 2% slope has a thin layer of gravel (2 cm - 1/2 inch.) at the bottom, covered by a layer of 10 to 12 cm (3.9 to 4.7 inch.) of the sand. The irrigation is made by a gravity flow at the bottom of the cultivation tank with a non-return nutrient solution, wetting the sand by capillarity.

Recent progress conducted to the development of a method based on a drip or trickle irrigation, which requieres cheaper materials (tank made of plastic sheet) and a more economical management. The comparison of the costs of production, between these two techniques of sand culture shows how large improvement have been made and where other progress can be further gain.

COMPARISON OF THE COMPONENTS OF THE TOTAL COST OF PRODUCTION OF TWO METHODS

Depreciation cost

Depreciation costs out of the total cost of production are influenced by the length of the crops cycle and the total investment (shed and cultivation tank) (graphs 1-3).

The absorbtion of the total depreciation is calculated for both compared methods on a three years basis. Past experience in French Guyana showed that well built concrete cultivation tanks do not have a longer life, mainly because of the soil instability which damage the slope, making them insuitable for vegetable production.

Plastic sheet tanks for trickle irrigation method can withstand that time because the slope is a secondary factor and upkeep is easy. So a significant improvement was made in changing the technique, as far as the investment and the cost of depreciation of the cultivation tank are concerned.

Upkeep

The upkeep of the installation has also been reduced by the new method. The main problem with capillarity irrigation was the mixing of the gravel of the lower layer with the sand. This consequently disturbs the flow of the water or of the nutrient solution. Once to twice a year, depending on the sand particle size, the gravel has to be cleaned up from the sand. This operation is expensive and time consuming (graphs 1-3). The trickle irrigation suppresses those upkeep fees since there is only sand in the tank.

Cultivation Cost

Cultivation costs have been somewhat reduced by the new method: specially for lettuces (graph 2). The main saving was made on the labor cost and on the nutrient solution. With the capillarity irrigation, a tillage for loosening the sand is necessary

because several superficial spraying have to be made after planting. This operation is not necessary with trickle irrigation, the structure of the sand not being destroyed by the dripped water.

Generally, the smaller bulk of sand to be wet and the localization of the nutrient solution allow a significant saving in water and nutrient solution with the trickle irrigation. For tomatoes and cucumbers (graph 1-3), labor costs were not very significantly reduced by the new method. The labor from pruning and training remains one of the main expenses followed by the nutrient solution.

COMPARISON OF THE PERCENTAGE OF EACH COMPONENT OUT OF THE TOTAL COST OF PRODUCTION

The percentage of the component out of the total cost of production is very meaningful, because it allows to point out which expenses are to be reduced because of their comparatively large percentage of the total cost of production (graph 4-6).

Considering the production of tomatoes, comparatively to the capillarity irrigation, the trickle irrigation method reduced very significantly the absorbtion of depreciation and upkeep fees from 62% to 44% out of the total cost. The cultivation cost for tomatoes with trickle irrigation is mainly from the labor fees for pruning, training and harvesting. The two first operations are on the way to be suppressed by the use of determinate bush type varieties or even indeterminate, grown on a metallic netting. Operation of treatment for pest control could also be reduced by use of systemic pesticide. Work is under way on this problem.

Lettuces have a low labor requirement on (graph 6); planting and harvesting are the main operations. Planting could probably be mechenized if the production is made on a large scale. For this crop, the depreciation of the shed is the highest percentage out of the total cost of production.

By way of illustration, the production price per kg of vegetable under French Guyana conditions are indicated with yield averege which are to be considered as a minimum yield (table 1).

Table 1. - Production Price (Francs) per kg. on Hydroponic Tank Harvest in French Guyana

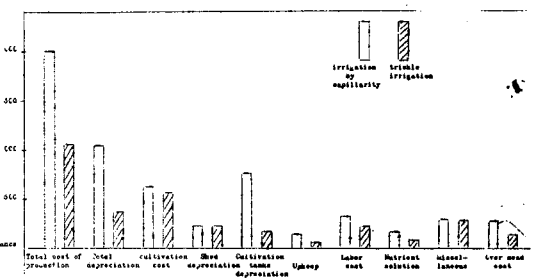
	Yield kg/m2	Capillarity irrigation	Trickle irrigation
Tomatoes (Floradel)	7.5 (1,5 lb/sq. Ft.)	2.50 F.	1.14 F.
Lettuces (Noran)	2.5 (0,59 lb/sq. Ft)	2.52 F.	0.91 F.
Cucumbers (Gemini 7)	20 (4,4 lb/sq. Ft.)	1.02 F.	0.53 F.

S U M M A R Y

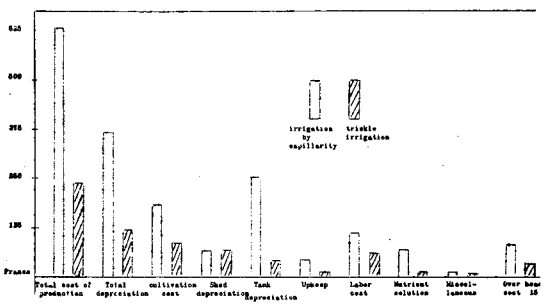
Hydroponic commercial produetion of vegetables on sand has now been practiced with success for five years in French Guyana, by small farmers on areas of about 200 m2 (600 Ft 2) and in a few larger farms on area from 1,000 m2 (3,281 Ft 2) up to 6,000 m2 (1.5 acre).

An hydrnponic technique of vegetable production had first been developed, with a simple feeder-system based on gravity flow in the bottom of the cultivation tanks with a non-return nutrient solution, the sand being wetted by capillarity. Further research recently conductad and economical considerations led to the development of a new method based on a drip or trickle irrigation requiring a cheapear material and allowing a more economical management.

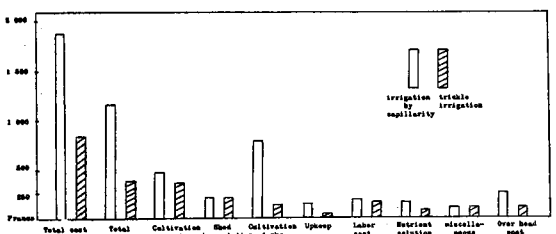
The paper studies the cost of production of both hydroponic mathods dascribed as "irrigation by capillarity" and "drip irrigation". The various components of the cost of production (absoption of depreciation, labor cost, nutrient solution etc.) are compared on a French francs basis and on the percentage of each component out of the total cost of production atand point. This analysis using bar graphs shows clearly the economical advantage of the developed method with trickle irrigation. It also shows the points where expenses could be further reduced, i.e. labor and cost of shed.



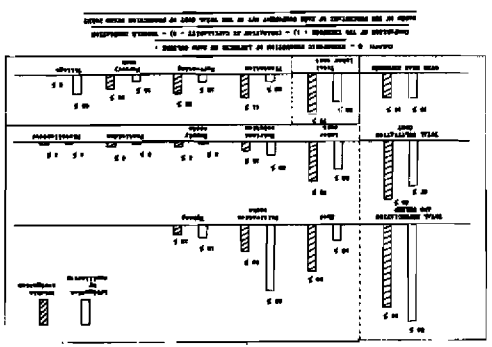
GRAPH 3 - HYDROPONIC PRODUCTION OF CUCUMBERS ON SAND CULTURE UNDER SHED
COMPARISON OF THE MAIN COMPONENTS OUT OF THE TOTAL COST OF PRODUCTION :
1) - Irrigation by capillarity - 2) - trickle irrigation

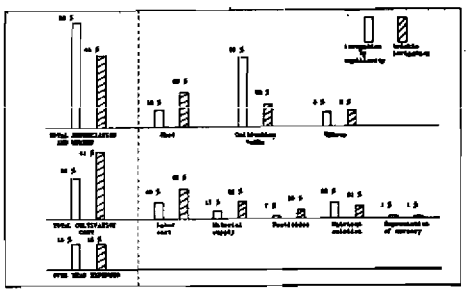


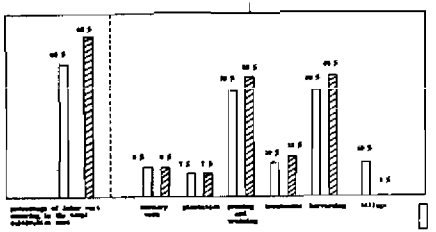
GRAPH 2 - HYDROPONIC PRODUCTION OF LETTUCES ON SAND CULTURE UNDER SHED
COMPARISON OF THE MAIN COMPONENTS OUT OF THE TOTAL COST OF PRODUCTION :
1) - irrigation by capillarity - 2) - trickle irrigation



GRAPH 1 - HYDROPONIC PRODUCTION OF TOMATOES ON SAND CULTURE UNDER SHED
COMPARISON OF THE MAIN COMPONENTS OUT OF THE TOTAL COST OF PRODUCTION
1) - IRRIGATION BY CAPILLARITY - 2) - TRICKLE IRRIGATION
* FOR 100 Sq. METERS (328 Sq. FT.)







CONSTRUCTION COST OF 100 M2 (388 FEET 2) OF SAND CULTIVATION TANK FOR TRICKLE IRRIGATION

M A Y 1 9 7 2

	LABOR		MATERIAL		TOTAL
Leveling and compacting	2 days x 48,00 F.	96,00			96,00
Installation of the plastic sheet	4 hours x 5,00 F.	20,00			20,00
Filling the tank with sand	1 day x 48,00 F.	48,00			48,00
Plastic sheet 200 micron			1,30 F./m2 x 200 m2	260,00	260,00
Punched pipe for drainage			P.V.C. 8,64 F./4 m x 28	247,52	247,52
Sand			20,00 F./m3 x 15 m3	300,00	300,00
Twin wall hose			0,80 F./m x 200	160,00	160,00
Irrigation pipes			100,00 F.	100,00	100,00
Labor for installation of irrigation material	4 hours x 6,82 F.	25,28			25,28
		189,28 F.		1 067,52 F.	1 256,80 F.

1 m2 (3,28 feet2) = 12,56 F.

COST OF CONSTRUCTION OF CONCRETE CULTIVATION T

4 TANKS OF 25 M X 1 M = 100 M2 (388 FEET2)

M A Y 1 9 7 2

	LABOR		MATERIAL		
STacking and leveling	2 days x 48,00 F.	96,00			96,00
Framing			reused 4 times	53,00	53,00
Masonry			concrete : 16,4 m3 x 240 F.	3 936,00	3 936,00
			" : 4,5 m3 x 500 F.	2 250,00	2 250,00
Other material			breeze-blocks 270 x 0,85 F.	229,50	229,50
			iron-matting 100mm x 3,00 F.	300,00	300,00
			miscellaneous	65,00	65,00
Flintkot	4 days x 48,00 F.	192,00	2 coats x 50,00 F.	100,00	292,00
Labor	contract	3325,00			3 325,00
Gravel (rice shape)			2 m3 x 65,00 F.	130,00	130,00
Gravel (5 x 15)			5 m3 x 67,00 F.	335,00	335,00
Sand			15 m3 x 14,00 F.	210,00	210,00
Filling the tanks	6 days x 40,00 F.	240,00			240,00
		3 853,00 F.		7 608,50 F.	11 461,50 F.

1 m2 (3,28 feet2) = 114,61 F.