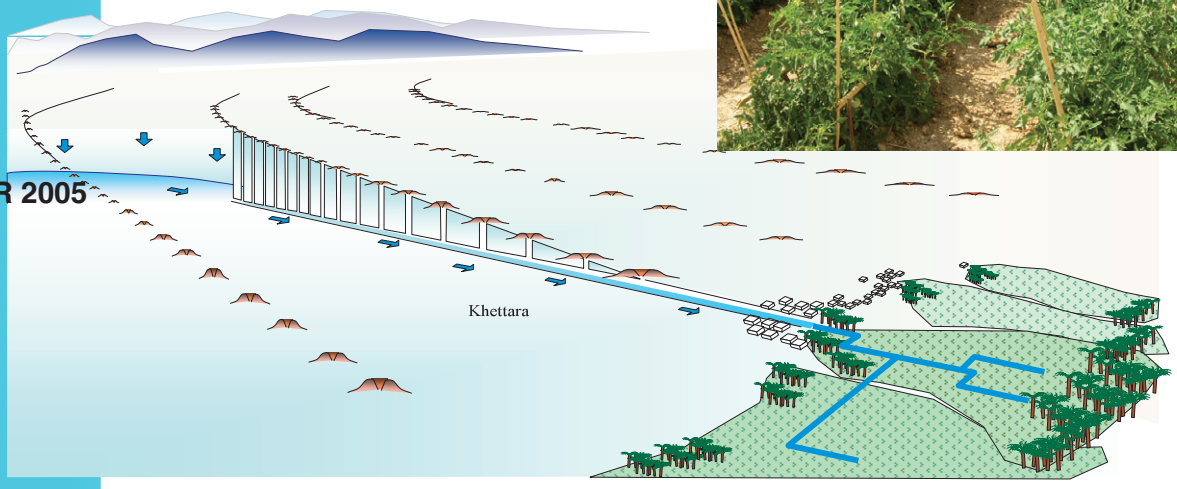
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NO.

MINISTRY OF AGRICULTURE, RURAL DEVELOPMENT AND SEA FISHERIES
REGIONAL AGENCY FOR RURAL DEVELOPMENT OF THE TAFILALET
THE KINGDOM OF MOROCCO

THE DEVELOPMENT STUDY ON RURAL COMMUNITY DEVELOPMENT PROJECT IN SEMI-ARID EAST ATLAS REGIONS WITH KHETTARA REHABILITATION IN THE KINGDOM OF MOROCCO

MANUAL FOR AGRICULTURE AND EXTENSION SERVICE



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The Development Study on Rural Comunity Development Project
in Semi-Arid East Atlas Regions with Khettara Rehabilitation

Manual for Agricultural and Extension Service

1. Introduction

This is the manual for agricultural extensions for Khettara area. The manual was prepared based on the result of a verification study. The verification study for agriculture and rural development had been implemented during 2 years from July 2004 to July 2005. The verification study included: i) adaptability test of vegetables under the water saving irrigation, ii) demonstration of agro-processing, iii) demonstration on income generation activities. Those results was included into the manual and, accordingly, the manual will be utilized to get practical ideas.

2. Basic Information of Agriculture in Tafilalet

2.1 Climate

The following metrological data measured by ORMVA-SMVA is shown for your reference.

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total	Ave.
Rainfall(mm/month)	8.5	14.8	8.2	8.2	9.0	5.8	1.9	3.2	5.2	20.0	13.6	11.6	110.0	9.2
vapolation (mm/month	59.3	89.0	149.2	195.8	245.8	301.1	336.0	298.7	226.4	157.5	81.8	52.9	2193.5	182.8
Evapolation (mm/day)	1.9	3.1	4.8	6.5	7.9	10.0	10.8	9.6	7.5	5.1	2.7	1.7	71.8	6.0
Temperature(℃)	6.7	9.6	13.1	16.6	21.1	26.1	29.4	28.6	24.1	17.7	12.0	7.5	212.5	17.7
Humidity(%)	55	51	43	39	36	29	23	26	35	45	53	58	493	41.1
Velocity(m/s)	0.6	0.6	0.9	1.3	1.3	1.1	1.3	1.0	1.0	0.6	0.5	0.7	10.9	0.9
Sunshine(hr/day)	8.0	8.6	8.9	9.8	10.2	10.4	10.0	9.2	8.8	8.7	8.4	7.8	108.8	9.1

Source: ORMVA-SEMVA

2.2 Soil

The soil survey for the study area was carried out in 2003. Table 2.1 presents soil class for irrigation. Attached table 2.2 presents a synthesis of soil unites, land capability classes and the proposed land managements for the studied perimeters. Results are grouped by zone as specified in this study. The main soil type present in the study area is a typical slightly developed soil according to the French classification used in Morocco. It corresponds to the xerochrept group of the soil Taxonomy. The second most frequent soil type is made of aerial sand deposits. It is classified as mineral soil in the French classification. The corresponding soil group in the soil Taxonomy is Psamment. Some perimeters contain other soil types such as the Isohumic soils (haploxerolls) or red Mediterranean soils (haploxaralfd or calcixerolls). These are relict soils from previous wetter climatic conditions.

Table 2.1 Definition of soil classes for irrigation

Class I

Soils suitable for cultivation under irrigation, permitting all crops adapted to the region (climate, water quality) and particularly intensive shrubs, with good productivity and nil or low expenses for soil improvement.

Class II

Soils suitable for cultivation under irrigation, having one or more limiting factors with medium importance:

- Either, improvable with medium cost and having the capability of Class I;
- Or, not or partially improvable and having a reduced aptitude for some demanding crops, or having a medium general productivity.

Class III

Soils suitable for cultivation under irrigation, having one or more important limiting factors:

- Either, totally improvable with high cost and having the capability of Class I;
- Or, partially improvable with medium or high cost and having the aptitude and productivity comparable to Class II;
- Or, not or slight improvable and having the aptitude to support only slightly demanding crops or having a reduced general productivity.

Class IV

Soils with non-improvable limiting factors. They allow irrigation only under special conditions. For example, rustic tree plantation, forage, isolated agricultural spots).

Class V

Soils, inappropriate for irrigation.

Class VI

Soils, unsuitable to any agricultural use.

Codification and cartography

The classification for irrigation land suitability is codified in a map by numbers written in Roman numerals representing the class, indexed by one or many letters which present the constraints justifying the reclassification. In principle, the letters used are initials of constraints (In French).

Examples:

Symbol	Constraint	French equivalent
P	Depth	**P**rofondeur
Pe	Slope	**Pe**nte
T	Texture	**T**exture
M	Micro-relief	**M**icro-relief
A	Alkalinity	**A**lcalinité
R	Salinity	Salinité
I	Flood Risk	Rique d'**I**nondation
Eh	water erosion	**E**rosion **h**ydrique
Ee	Wind erosion	**E**rosion **é**olienne
C	Stoniness	**C**harge en caillox
D	Drainage (Hydraulic conductivity)	**D**rainage (Conductivité hydraulique)
K	Vertical Permeability	**P**erméabilité verticale

The following tables present the land capability/suitability classification officially used in Morocco by all soil survey studies for irrigation management:

- Soil depth

Symbol	Designation	Depth (cm)
P1	Very deep	> 80
P2	Deep	60 to 80
P3	Moderately deep	40 to 60
P4	Slightly deep	20 to 40
P5	Skeletal	0 to 20

- Hydraulic conductivity (internal drainage)

Symbol	Designation	D (m/j)
D1	Very high	> 2
D2	High	1 to 2
D3	Medium	0.1 to 1
D4	Low	0.05 to 0.1
D5	Very low	< 0.05

- Vertical permeability

Symbol	Designation	K (cm/h)
K'4	Very high	> 20
K2	High	10 to 20
K1	Medium	2 to 10
K3	Low	1 to 2
K4	Very low	0.5 to 1
K5	Extremely low	< 0,5

- Salinity

Symbol	Designation	EC of saturated past (dS/m)
R1	Not saline	< 4
R2	Slightly saline	4 to 8
R3	Saline	8 to 16
R4	Strongly saline	16 to 32
R5	Very strongly saline	> 32

- Alkalinity: (Na/CEC)*100

Symbol	Designation	ESP (%)
A1	Not sodic	< 10
A2	Slightly sodic	10 to 15
A3	Moderately sodic	15 to 20
A4	Strongly sodic	20 to 30
A5	Very strongly sodic	> 30

- Micro topography

Symbol	Designation	Relief level (cm)
M1	Nil	< 15
M2	Low	15 to 30
M3	Medium	30 to 60
M4	High	60 to 120
M5	Very high	> 120

- Calcium carbonate content

Symbol	Designation	Contents (%)
Ca1	Low	< 7
Ca2	Medium	7 to 15
Ca3	High	15 to 25
Ca4	Very high	> 25

- Stoniness

Symbol	Designation	Contents (%)
C1	Very low	< 10
C2	Low	10 to 25
C3	Medium	25 to 50
C4	High	50 to 75
C5	Very high	> 75

- Slope

Symbol	Designation	%
Pe1	Nil	< 1
Pe2	Weak	1 to 1.5
Pe3	Medium	1.5 to 2.0
Pe4	Strong	2.0 to 4.0
Pe5	Very strong	> 4.0

- Water erosion (Eh) and Wind erosion (Ee)

Symbol	Designation	Symbol	Appellation
Eh1	No	Ee1	No
Eh2	Low	Ee2	Low
Eh3	Moderate	Ee3	Moderate
Eh4	Strong	Ee4	Strong
Eh5	Badlands	Ee5	Moving sand dunes

- Texture

Symbol	Designation	Texture
T4	Very coarse	S
T3	Coarse	SL
T2	Silty	LF, LTF
T1	Medium	AS, LAS, L, LS, LTS
T'2	Fine	A, AL, LA
T'3	Very fine	AA
Tg2	Gravelly	Gravel (10 to 25 %)
Tg3	Moderately gravelly	Gravel (25 to 50 %)
Tg4	Very gravelly	Gravel (50 to 75 %)

Soil Survey Result in the Study Area

Zone A : Goulmima - Tinjdad

Perimeters	Soil units	Land capability classes	Land managements
Ait My El Mamoun	**Unit 1**: Very deep, coarse, typic, slightly developed alluvial soils.	II.P	- Wind erosion and sand accumulation control. - Manure application
	Unit 2: Aerial sand deposit mineral soils.	IV.T.Ee	- Wind erosion and sand accumulation control. - Manure application
Assoul Jdida	Very deep, medium textured, slightly saline, slightly developed alluvial soils.	II.R.A.T	No management required
Assoul Kdima	Very deep, fine, typic, slightly developed alluvial soils.	II.T	No management required
Bakkassia	**Unit 1**: Very deep, coarse, typic, slightly developed alluvial soils.	III.T/II.P	- Wind erosion and sand accumulation control. - Manure application
	Unit 2: Aerial sand deposit mineral soils	IV.T.Ee	- Wind erosion and sand accumulation control. - Manure application
Isilf	**Unit 1**: Very deep, medium textured, slightly saline, slightly developed alluvial soils.	I	- Wind erosion and sand accumulation control. - Manure application
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee	- Wind erosion and sand accumulation control. - Manure application
Litama	**Unit 1**: Very deep, fine, typic, slightly developed alluvial soils.	II.T	- Wind erosion and sand accumulation control.
	Unit 2: Very deep, medium textured, typic, slightly developed alluvial soils.	I	- Wind erosion and sand accumulation control.
	Unit 3: Aerial sand deposit mineral soils.	IV.T.Ee	- Wind erosion and sand accumulation control.
	Unit 4: very deep, coarse, saline, slightly developed alluvial soils.	II.T.R	- Wind erosion and sand accumulation control.
Ouinigui	**Unit 1:** Moderately deep, medium textured, slightly developed alluvial soils.	III.P	No management required
	Unit 2: Very deep, medium textured, slightly developed alluvial soils.	II.P	No management required
Oukhit	**Unit 1**: Deep, medium textured, typic, slightly developed alluvial soils.	II.P.T	Manure application
	Unit 2: Moderately deep, fine, typic, slightly developed alluvial soils.	III.P/II.T	Manure application
Ait Ba Maati	**Unit 1**: Very deep, coarse, typic, slightly developed alluvial soils.	III.T	- Wind erosion and sand accumulation control. - Manure application
	Unit 2: Aerial sand deposit mineral soils.	IV.T.Ee	- Wind erosion and sand accumulation control. - Manure application
Tarhia	**Unit 1**: Very deep, medium textured, typic, slightly developed alluvial soils.	I	Important manure application
	Unit 2: Moderately deep, medium textured, slightly developed alluvial soils.	III.P	Important manure application
Taltfraout	Very deep, medium textured, slightly saline, slightly developed alluvial soils.	II.R.A	No management required

Zone B : Béni Tadjit

Perimeters	Soil units	Land capability classes	Land managements
Ait Fdouli	Very deep, coarse, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee	Wind erosion and sand accumulation control.
Ait Ouazzag	Very deep, medium textured, slightly saline, slightly developed alluvial soils.	II.R.A	Salt removal.
Ait Sbaa	Very deep, fine silty, typic, slightly developed alluvial soils.	II.T	No management required
Almou N'Chorfa	Very deep, fine silty, typic, slightly developed alluvial soils.	II.T	No management required

Zone C : Errachidia – Boudnib

Perimeters	Soil units	Land capability classes	Land managements
Boudnib Jdida	**Unit 1**: Very deep, medium textured, typic, slightly developed alluvial soils.	I	No management required
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee	Wind erosion and sand accumulation control.
Ouled Ali	**Unit 1**: Very deep, medium textured, typic, slightly developed alluvial soils.	I	No management required
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee	Wind erosion and sand accumulation control.

Zone D : Fezna – Jorf - Hannabou

Perimeters	Soil units	Land capability classes	Land managements
Lhayen -Bouchabia	Very deep, medium textured, very slightly saline, Slightly developed aerio-alluvial soils.	V.R.A	No management required
El Bouya Jdida	**Unit 1**: Aerial sand deposit mineral soils.	IV.T.Ee	Wind erosion and sand accumulation control.
	Unit 2: Very deep, medium textured, Slightly developed aerio-alluvial soils.	III.Ee	Wind erosion and sand accumulation control.
El Bouya Melha	**Unit 1**: Very deep, medium textured, typic, Slightly developed aerio-alluvial soils.	II.A	- Wind erosion and sand accumulation control. - Manure application
	Unit 2: Very deep, coarse, sand deposit accumulated, Slightly developed aerio-alluvial soils.	IV.T.Ee	Wind erosion and sand accumulation control.
Hannabou -Khtitira	**Unit 1**: Very deep, medium textured, typic, Slightly developed alluvial soils.	I	No management required

	Unit 2: Very deep, medium textured to coarse, sand deposit accumulated, Slightly developed alluvial soils.	IV.T.Ee/III.A/II.R	- Wind erosion and sand accumulation control - Salt removal
Ksiba	**Unit 1**: Very deep, fine, typic chestnut (brown) soils. (*Hamra*)	II.T	Manure application
	Unit 2: Very deep, medium textured to coarse, slightly saline, slightly developed alluvial soils *(N'til).*	II.R	Manure application
Laachouria Kdima	Very deep, fine, slightly saline, slightly developed alluvial soils.	II.R.A.T	No management required
Hannabou-Lagrinia	**Unit 1**: Aerial sand deposit mineral soils	IV.T.Ee	- Wind erosion and sand accumulation control. - Manure application
	Unit 2: Very deep, fine silty, slightly saline, slightly developed aerio-alluvial soils.	II.Ee	- Wind erosion and sand accumulation control. - Manure application
Monkara	**Unit 1**: Very deep, fine to medium textured, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee	Wind erosion and sand accumulation control.
	Unit 2: Very deep, fine to medium textured, sodic and saline, slightly developed alluvial soils.	IV.R.A	Salt removal and drainage
Lakrayer	**Unit 1**: Very deep, medium textured, slightly saline, slightly developed alluvial soils.	II.R	Wind erosion and sand accumulation control.
	Unit 2: Very deep, fine to medium textured to coarse, sand deposit accumulated, slightly developed alluvial soils.	II.Ee	Wind erosion and sand accumulation control.
Tarra-Louaria	Very deep, medium textured to silty, typic, slightly developed alluvial soils.	I	Wind erosion and sand accumulation control
Hannabou-Mostafia	**Unit 1:** Aerial sand deposit mineral soils	IV.T.Ee	Wind erosion and sand accumulation control.
	Unit 2: Very deep, slightly saline, partially sand deposit accumulated, slightly developed alluvial soils.	III.A	- Salt removal, drainage - Wind erosion and sand accumulation control.
Ouled Ghanem Kdima	**Unit 1**: Very deep, medium textured, slightly saline, sand deposit accumulated, slightly developed alluvial soils.	II.R.A.Ee	- Wind erosion and sand accumulation control - Manure application
	Unit 2: Very deep, sandy, slightly developed aerio-alluvial soils.	IV.T.Ee	Wind erosion and sand accumulation control.
Ouled Ghanem Souihla	**Unit 1**: Very deep, silty, slightly saline, slightly developed alluvial soils.	II.R.A.T	- Manure application - Salt removal
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed alluvial soils.	III.T.Ee	Wind erosion and sand accumulation control.
Ouled Jellal	**Unit 1**: Very deep, silty, slightly saline, slightly developed alluvial soils.	II.R.A.I.	- Manure application - Flooding protection (Oued Ghris)

	Unit 2: Very deep, fine, chestnut (brown) soils.	II.T.I.	- Manure application - Flooding protection (Oued Ghris)
Ouled M'barek Jdida	**Unit 1**: Very deep, medium textured to fine, saline, slightly developed alluvial soils.	III.R.A	- Surface drainage - Salt removal
	Unit 2: Very deep, coarse, slightly saline, slightly developed alluvial soils.	III.T.Ee	Wind erosion and sand accumulation control.
Gfifat - Yahiaouia	**Unit 1**: Very deep, fine, typic, slightly developed alluvial soils.	II.T.A	- Manure application - Wind erosion and sand accumulation control.
	Unit 2: Very deep, sandy, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee	- Manure application - Wind erosion and sand accumulation control.
Ouled Brika - Zerguia	**Unit 1**: Very deep, medium textured, saline, slightly developed alluvial soils.	III.R.A	Salt removal
	Unit 1: Very deep, light textured, saline, slightly developed alluvial soils.	III.R.A.Ee	- Salt removal - Wind erosion and sand accumulation control.

Zone E : Sifa

Perimeters	Soil units	Land capability classes	Land managements
Ighzer	Very deep, sandy, salt affected soils	V.R/IV.T.Ee.A	- Wind erosion and sand accumulation control - Salt removal
Ksour Sifa Cherchmia	**Unit 1**: Very deep, fine, slightly saline, slightly develop alluvial soils.	III.T.R.A	- Wind erosion and sand accumulation control - Manure application
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed aerio-alluvial soils.	IV.T.Ee	- Wind erosion and sand accumulation control - Manure application
Ksour Sifa Haj allal	**Unit 1**: Very deep, medium textured, slightly saline, slightly developed alluvial soils.	II.R.A	- Wind erosion and sand accumulation control - Manure application
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed aerio-alluvial soils.	IV.T.Ee	- Wind erosion and sand accumulation control - Manure application
Ksour Sifa Kdima	**Unit 1:** Very deep, coarse to medium textured, slightly saline, slightly developed alluvial soils.	III.T.A/II.R	- Wind erosion and sand accumulation control - Manure application
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed aerio-allivial soils.	IV.T.Ee	- Wind erosion and sand accumulation control - Manure application

Zone F : Rissani - Taouz

Perimeters	Soil units	Land capability classes	Land managements
Beggaa	Very deep, coarse to medium textured, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee	Wind erosion and sand accumulation control
Haroun	**Unit 1**: Very deep, very coarse, saline, slightly developed alluvial soils.	III.T.A/II.R	- Wind erosion and sand accumulation control - Salt removal
	Unit 2: Very deep, very coarse, Aerial sand deposit mineral soils.	IV.T.Ee	- Wind erosion and sand accumulation control - Salt removal
Hassi Labiad	Very deep, coarse to medium textured, saline, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee, III.A et II.R	- Wind erosion and sand accumulation control - Salt removal
Merzouga - Talaabast	**Unit 1**: Very deep, medium textured, typic, slightly developed alluvial soils.	I	Wind erosion and sand accumulation control
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed alluvial soils.	IV.T.Ee	Wind erosion and sand accumulation control
Merzouga - Tamaright	Very deep, medium textured, slightly saline, slightly developed alluvial soils.	II.R.A	- Wind erosion and sand accumulation control - Manure application - Salt removal
Merzouga - Tamazzant	Very deep, coarse to medium textured, typic, slightly developed alluvial soils.	III.T	Manure application

Zone G : Alnif

Perimeters	Soil units	Land capability classes	Land managements
Achich N'ait Yazza	**Unit 1**: Deep to very deep, medium textured, slightly developed alluvial soils.	II.P à III.P	No management required
	Unit 2: Very deep, coarse, sand deposit accumulated, slightly developed aerio-alluvial soils.	III.P à IV.P	No management required
Afrou N'ait Lghazi	**Unit 1**: Moderately deep, coarse, slightly developed alluvial soils on schist.	III.T.P	- Surface stones removal - Manure application
	Unit 2: Slightly deep, fine, slightly developed alluvial soils on schists.	IV.P	- Surface stones removal - Manure application
Ait Zeggane	Very deep, fine silty, typic, slightly developed alluvial soils.	III.T.Ee	- Wind erosion and sand deposit control - Manure application
Alnif	Very deep, medium textured, slightly saline, slightly developed alluvial soils.	II.R.A	Manure application
Ammar Jdida	**Unit 1**: Very deep, fine, soft calcium carbonate accumulation, slightly developed alluvial soils.	II.T	Manure application
	Unit 2: Slightly to moderately deep, medium textured, slightly developed alluvial soils.	III.P	No management required

Azag	Very deep, heterogeneous textured, slightly developed aerio-alluvial soils.	II.T	Manure application
Battou	**Unit 1**: Very deep, medium textured, typic, slightly developed alluvial soils.	I	Manure application
	Unit 2: Very deep, medium textured, saline, slightly developed alluvial soils.	II.R	Manure application
	Unit 3: Slightly to moderately deep, coarse to medium textured, slightly developed soils.	III.P/II.I	- Flooding protection - Manure application
Imi N'Ouzrou	**Unit 1**: Deep to moderately deep, silty, recarbonated chestnut soils (*Azouggagh*).	III.P	No management required
	Unit 2: Very deep, medium textured, slightly developed alluvial soils.	I	No management required
Tachaoufit	Very deep, medium textured, slightly saline, slightly developed aerio-alluvial soils.	IV.Ee/II.R.A.I	- Wind erosion and sand deposit control - Flooding protection - Manure application
Takacha	**Unit 1**: Very deep, fine, isohumic brown soils.	II.T.Ee	- Manure application - Wind erosion and sand deposit control
	Unit 2: Very deep, medium textured, slightly developed alluvial soils.	I	No management required
	Unit 3: Very deep, coarse, slightly developed alluvial soils.	III.T.I	- Flooding protection - Manure application
Talghazit	Slightly deep, medium textured, laying on a gravelly and stony level, slightly developed alluvial soils.	III.P	Manure application
Tiguirna	**Unit 1:** Very deep, medium textured, slightly developed alluvial soils.	I	Wind erosion and sand deposit control
	Unit 2: Deep, medium textured, slightly developed alluvial soils.	II.P	Wind erosion and sand deposit control
	Unit 3: Very deep, coarse, sand deposit accumulated, slightly developed aerio-alluvial soils.	IV.T.Ee	Wind erosion and sand deposit control
Tinifift	**Unit 1**: Very deep, medium textured, typic, slightly developed alluvial soils.	I	No management required

3. Crops

3.1 General

The verification study made by JICA Study Team and ORMVA-TF showed that vegetable cultivation can produce good benefit under the irrigation condition, if farmer follow the guideline. In this chapter, the techniques of vegetable cultivations such as turnip, carrots, tomato, gumbo, water melon, and melon are explained based on the experience in the verification study. In addition to vegetable cultivation, caper crop as new crop and general techniques for faming is also explained.

(1) Characteristics of Vegetables

For the selection of vegetables, the tolerance against sunshine, temperature, dried soil, and salt should be considered. The following is the guideline used in Japan for your reference. It is noted that you have to check the tolerance of the variety, since different variety of the same crop shows different tolerance.

Tolerance against sunshine

Degree	Crop
High tolerance	Eggplant, tomato, cucumber, green pepper, pumpkin, potato, gumbo, maize, sesame, groundnut, red pepper, strawberry, turnip
Medium tolerance	Cabbage, onion, turnip, ginger, lettuce, broad beans, carrot
Low tolerance	Spinach

Source: Guidebook on cultivation of the vegetable without agro-chemicals, JICC 1989

Tolerance against high temperature

Degree	Crop
High tolerance	Eggplant, tomato, cucumber, green pepper, gumbo, sesame, groundnut, red pepper, ginger,
Medium tolerance	Spinach, pumpkin, carrot, maize, onion, turnip, lettuce, broad beans,
Low tolerance	Strawberry, potato, cabbage, radish, broad beans,

Source: Guidebook on cultivation of the vegetable without agro-chemicals, JICC 1989

Tolerance against less water (dried soil)

Degree	Crop
High tolerance	Pumpkin, groundnut, potato, sesame, maize,
Medium tolerance	Cabbage, tomato, broad beans, red pepper, lettuce, green pepper,
Low tolerance	Cucumber, strawberry, spinach, 0nion, turnip, ginger, carrot, eggplant, gumbo, radish,

Source: Guidebook on cultivation of the vegetable without agro-chemicals, JICC 1989

Tolerance against salt

Degree	Crop
High tolerance	Asparagus, beet, zucchini
Medium tolerance	Broccoli, cabbage, cauliflower, cucmber, lettuce, pepper, potato, tomato, turnip, watermelon
Low tolerance	Bean, carrot, onion

Source: University of Wyoming, 1994

(2) Crop rotation

For the selection of vegetables, the crop rotation should be considered, since some crop s cannot cultivate continuously or in a short interval. The following is the guideline on the sensitivity used in Japan for your reference.

Sensitivity on continuous cultivation

Degree	Crop
Possible to cultivate continuously	Spinach, maize, pumpkin, gumbo, sesame
1-2 years interval	Turnip, radish, groundnut,
2-3 years interval	Cabbage, lettuce, onion, cucumber, strawberry, carrot, ginger
3-4 years interval	Tomato, potato
4-4 years interval	Eggplant, green pepper, red pepper, broad beans,

Source: Guidebook on cultivation of the vegetable without agro-chemicals, JICC 1989

3.2 Nursery preparation

(1) Procedure

Nursery will be prepared in some crops such as tomato, melon and watermelon for protection of cold weather, winds and livestock etc. Alveolus plate will be arranged through suppliers and peat soils will be filled up in each pole of the alveolus plates. Then, one seed will be put in each soil in the depth of 0.5 – 1.0 cm. Very deep position of seed is negative effect to the germination. Shortage of soil water should be avoid and therefore water should be supplied from time to time. Seeds will be geminated 5 – 10 days after the seeding if soil temperature kept at 25 – 30 ℃. Therefore, temporary plastic house or tunnel is recommendable in March to increase or keep the temperature of nursery box. Around 25 to 30 days letter, the seedling will be transplanted to the field. The problem seedlings such as poor growth, disease leaf or root, poor should be removed to arrange uniform growth condition.

(2) Cost

Inputs for nursery preparation are shown in the following table.

Crop	Density (Plant/ha)	Seeds (Kg/ha)	Nursery (Per ha)	
			Alveolus plates	Dig peat
Tomato	28000 - 33000	0.1 - 0.15 kg	300	40 - 50 bag
Melon	10000	2.5 - 3.5 kg	135	18 - 22 bag
watermelon	5000	3 - 3.5 kg	71	9 - 11 bag

✓ Dig peat

Soils containing a plenty of organic materials, used for nursery preparation.
Volume of each bag of peat: 70 - 80 litre, or 20 - 25 kg. Cost : 70 - 80 dh/bag,

✓ Alveolus plate

Alveolus plate has 77 cells. One seed is sown in each cell.
Cost : 7 – 8 dh/ alveolus e plate.

3.3 Turnip

(1) Characteristic

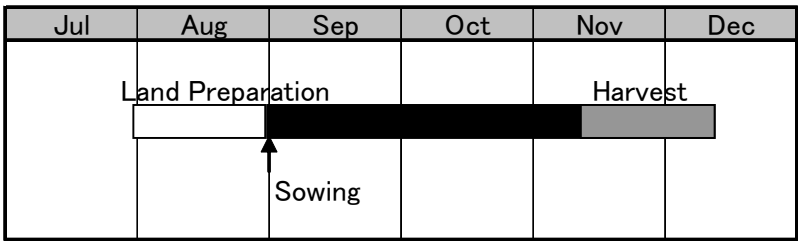
Turnips (Brassica campestris) in Tafilaet are planted from September through December and harvested from November to February. If it was sown too early or harvested too late, the turnips can suffer adverse effects from high temperatures. Turnips shows best grow at temperatures ranging from 10° to 18.3°C. Many varieties of turnip are available consisting of different sizes, shapes and colors. Drought residence to the initial growth stage (up to the development of fifth leaf) of turnip is very low and, accordingly, the maintenance of soil contained water is important in this stage. High temperatures and unfavorable growing conditions such as shortage of irrigation water will produce strong-flavored roots and reduce the root quality.

(2) Variety

Crops	Variety used in the JICA Study	Others variety
Turnip	Marteau	Jaune Boule d'or, Blanc de croissy, Royal crown

(3) Cropping Calendar

Growth Period: Around 100 days



(For your reference see records of Verification Study in the next page)

Lambarkia, Jorf

Crop	Irrigation Method	Plowing	Application of Organic Manure	Basic Fertilizer	Land Preparation	Sowing	Thinning (Initial)	Thinning	Weeding	Supplemental Fertilizer	Harvest
Turnip	Drip irrigation	2004/8/15	2004/9/9	2004/9/11	2004/9/11	2004/9/11	2004/10/1-6, 2004/10/17	2004/10/15-25	2004/10/30	2004/10/1	2004/11/7-2004/12/28
	Fallow irrigation with reservoir	2004/8/15	2004/9/9	2004/9/13	2004/9/13	2004/9/15	2004/10/1-6, 2004/10/17	2004/10/10-28	2004/10/30	2004/10/1	2004/11/5-2005/01/25
	Fallow irrigation without reservoir	2004/8/15	2004/9/9	2004/9/13	2004/9/13	2004/9/14	2004/10/11-14	2004/10/21-22	2004/10/30	2004/10/1	2004/11/5-2004/12/18
	Traditional irrigation	2004/8/15	2004/9/13	2004/9/13	2004/9/13	2004/9/13		2004/10/1-2	2004/10/30	2004/10/1	2004/11/28-2004/12/30

Taoumarte, Alnif

Turnip	Fallow irrigation with reservoir	2004/9/9	2004/9/11	2004/9/11	2004/9/11	2004/9/12	2004/10/10	2004/10/13-28	2004/10/18-19	2004/10/17	2004/10/27-2004/01/18
	Fallow irrigation without reservoir	2004/9/1	2004/9/6	2004/9/7	2004/9/8	2004/9/9	2004/10/8	2004/10/8	2004/10/19	2004/11/4	2004/10/28-2004/11/17
	Traditional irrigation	2004/8/6	2004/9/1	2004/9/3	2004/9/2-3	2004/9/10		2004/10/1-2		2004/11/5	2004/11/08-2004/01/03

(4) Cultivation methodology

Preparatory work

Basic fertilizer and organic manure are applied in the bottom of beds. Turnip roots may fork if too much N is applied pre-plant. Nitrogen deficient turnip often have leaves with an apparently healthy green appearance, but the height of tops throughout the field may be irregular. 90 kg per ha or P2O5 and 100 kg per ha of K20 per ha are applied.

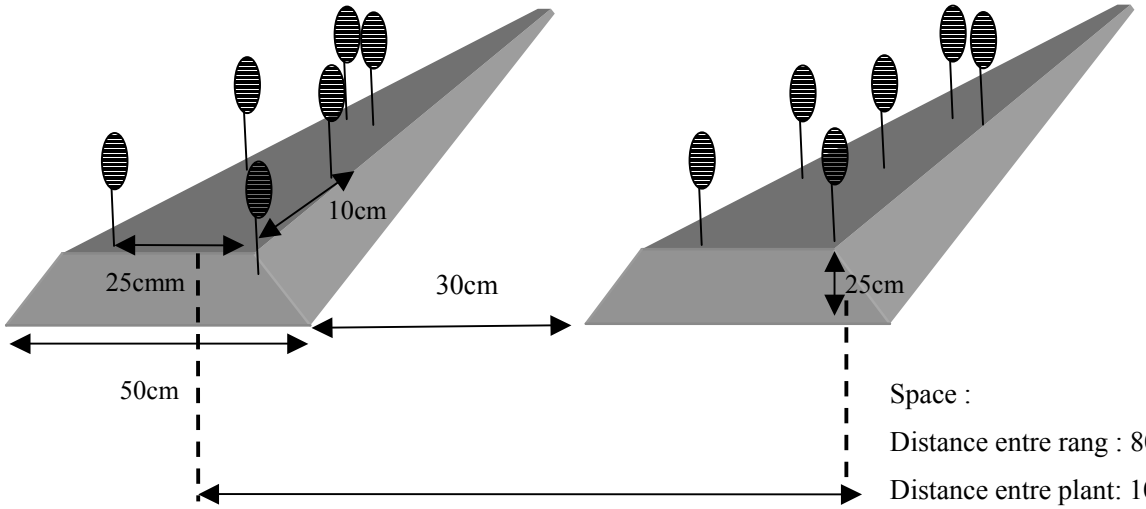
N	P2O5	K20	Organize Manure
60-80 kg/ha	90 kg/ha	100 kg/ha	20 ton/ha

Spacing

Seed: 5 - 10 kg/ha

Density:

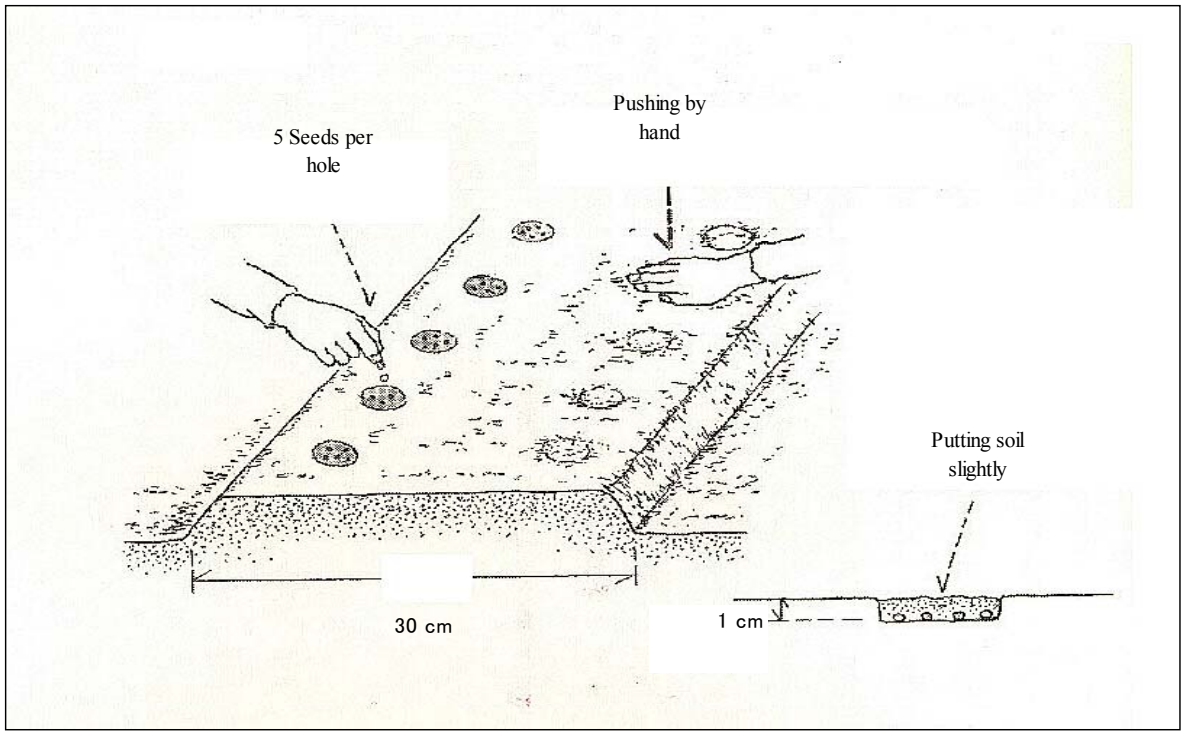
Drip Irrigation and Furrow Irrigation



Space :
Distance entre rang : 80cm
Distance entre plant: 10 cm
Distance entre ligne : 25 cm
Density: 250000 plants/ha
Ligne jumelée

Sowing for Turnip

Carrots are always direct seeded. Turnip seed are sown at the rate of 5 live seed per small hole. Seeds are most commonly sown in 2 lines in beds 30 cm wide (Please refer to the following figure). Seeds are lightly covered by soils. It is very important to keep wet condition of soil up to the fifth leave stage in turnip.



Turnip prefers strong sunshine. Therefore, thinning is required to reduce density of crops. First time of thinning will be made one month at 2-3 leaves stage. 3 seedlings are left. Second time of thinning will be made at 4-5 leaves stage, only one seedling is left.

Supplemental fertilizer

Around 15 days – 30 days after sowing, the supplemental fertilizer should be applied. Only nitrogen fertilizer will be applied.

N	P2O5	K20	Organize Manure
80 kg/ha	-	-	-

Weed control

Weeds are removed from time to time. Hand weeding and timely shallow cultivation will reduce weed pressure. You can rotate turnips with cover crops or green manure crops or use herbicides to control weeds, if necessary.

(5) Cost and Benefit

Cost based on the verification study in 2004

Inputs Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Seeds			
Turnip	10 kg/ha	48 DH/kg	480 DH
Organic Manure	20 ton/ha	120 DH/ton	2,400 DH
Chemical Fertilizer			
14-28-14	600 kg/ha	2.95 DH/kg	1,770 DH
N-Amoni (21%)	500 kg/ha	1.84 DH/kg	920 DH
Agro-Chemicals	1 bottle/ha	40 DH/bottle	40 DH
Tractor	16 hr/ha	60 DH/hr	960 DH
Labor Cost	23 man-day/ha	40 DH/man-day	920 DH
Total Input Cost per ha			7,490 DH

Selling price based on the verification study in December 2004 (DH/kg)

	Ait Ben Omar, Tinejdat	Lambarki, Jorf	Taoumart, Alnif
Average price	1.03	0.48	0.96
Lowest price	0.75	0.30	0.40
Highest price	2.00	2.00	2.00
Remarks	Local market price	Local market and farm gate prices	Local market price

Income based on the verification study in December 2004

Name of Khettara	Irrigation Method	Area	Total Production (kg)	Production per Ha (Kg/ha)	Income at DH 0.5/kg (DH/ha)	Income at Actual Price (DH/ha)
Ait Ben Omar	Drip irrigation	0.07	1,245	17,800	8,900	17,700
(Tinjdad)	Fallow irrigation with reservoir	0.04	296	7,400	3,700	7,120
	Fallow irrigation without reservoir	0.05	300	6,000	3,000	5,760
	Traditional irrigation	0.08	1,540	19,300	9,650	19,900
Lambarkia	Drip irrigation	0.06	1,802	30,000	15,000	17,500
(Jorf)	Fallow irrigation with reservoir	0.06	1,351	22,500	11,250	12,200
	Fallow irrigation without reservoir	0.05	1,291	25,800	12,900	11,600
	Traditional irrigation	0.10	2,154	21,500	10,750	39,500
Taoumart	Fallow irrigation with reservoir	0.07	2,669	38,100	19,050	37,300
(Alnif)	Fallow irrigation without reservoir	0.07	3,629	51,800	25,900	45,400
	Traditional irrigation	0.05	1,257	25,100	12,550	13,100

3.4 Carrot

(1) Characteristic

Carrot (Daucus carota L.) in Tafilaet are planted from August through September and harvested from December to March. Carrots, a cool-season crop, will tolerate warm temperatures early in the growing season. Roots attain optimal color when the air temperature is 16° to 21°C. Root color will deepen rapidly when temperature is within this range 3 weeks before harvest. However, root color will decline at higher temperatures. Therefore, "white root" (pale color) is most often observed in late-planted crops. Above 30°C, the growth of leaf is reduced and strong flaw develop in the roots, reducing their market quality. Below 10°C carrot roots and leaf grow slowly. Carrots tolerate some frost.

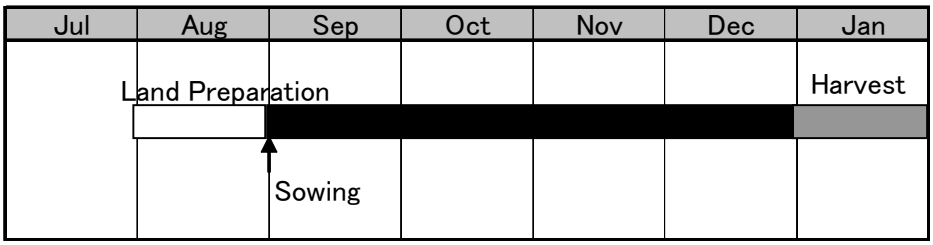
Germination of seeds is sometimes troubles, since carrots indicate high sensitivity to drought and low temperature in the germination stage. Soil cover to the seeds should be thin, since the carrot seed needs light for the germination. In the growth stage, high soil moisture is required, since carrot is not so strong

(2) Variety

Crops	Variety used in the JICA Study	Others variety
Carrot	Muscat	La Nantaise, Nandor, Racelido

(3) Cropping Calendar

Growth Period: Around 130-150 days



Lambarkia, Jorf

Crop	Irrigation Method	Plowing	Application of Organic Manure	Basic Fertilizer	Land Preparation	Sowing	Thinning (Initial)	Thinning	Weeding	Supplemental Fertilizer	Harvest
Carrot	Drip irrigation	2004/8/15	2004/9/9	2004/9/11	2004/9/11	2004/9/11	2004/10/1-6 2004/10/10-17	2004/10/15-25	2004/10/30	2004/10/1	2004/12/17-2005/02/18
	Fallow irrigation with reservoir	2004/8/15	2004/9/9	2004/9/13	2004/9/13	2004/9/15	2004/10/1-6 2004/10/10-17	2004/10/13-14 2004/10/28	2004/10/30	2004/10/1	2004/12/17-2005/02/18
	Fallow irrigation without reservoir	2004/8/15	2004/9/9	2004/9/13	2004/9/13	2004/9/14	2004/10/11-14	2004/10/20-21	2004/10/30	2004/10/1	2004/12/22-2005/02/18
	Traditional irrigation	2004/8/15	2004/9/13	2004/9/13	2004/9/13	2004/9/13		2004/10/1-2	2004/10/30	2004/10/5	2004/12/22-2005/02/18

Taoumarte, Alnif

Carrot	Fallow irrigation with reservoir	2004/9/9	2004/9/11	2004/9/11	2004/9/11	2004/9/12	2004/10/10	004/10/14-28	2004/10/18-19	2004/10/17	2004/11/20-2005/02/18
	Fallow irrigation without reservoir	2004/9/1	2004/9/6	2004/9/7	2004/9/8	2004/9/9	2004/10/9	2004/10/9	2004/10/19	2004/11/4	2004/11/20-2005/02/18
	Traditional irrigation	2004/8/6	2004/9/1	2004/9/3	2004/9/2-3	2004/9/10		2004/10/1-2		2004/10/1	2005/01/02-20054/02/18

(4) Cultivation methodology

Preparatory work

Basic fertilizer and organic manure are applied in the bottom of beds. Carrot roots may fork if too much N is applied pre-plant. Nitrogen-deficient carrots often have leaves with an apparently healthy green appearance, but the height of tops in the field will be sometimes irregular.

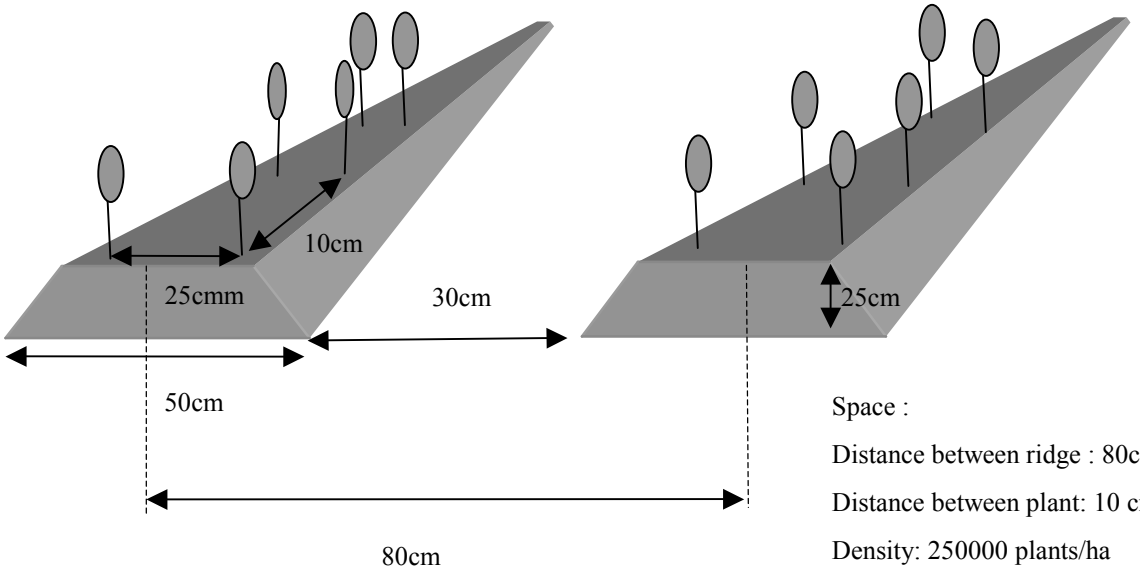
N	P2O5	K20	Organize Manure
60-80 kg/ha	90 kg/ha	100 kg/ha	20 ton/ha

Spacing

Seed: 5 – 10 kg/ha

Density:

Drip Irrigation and Furrow Irrigation



Space :

Distance between ridge : 80cm

Distance between plant: 10 cm

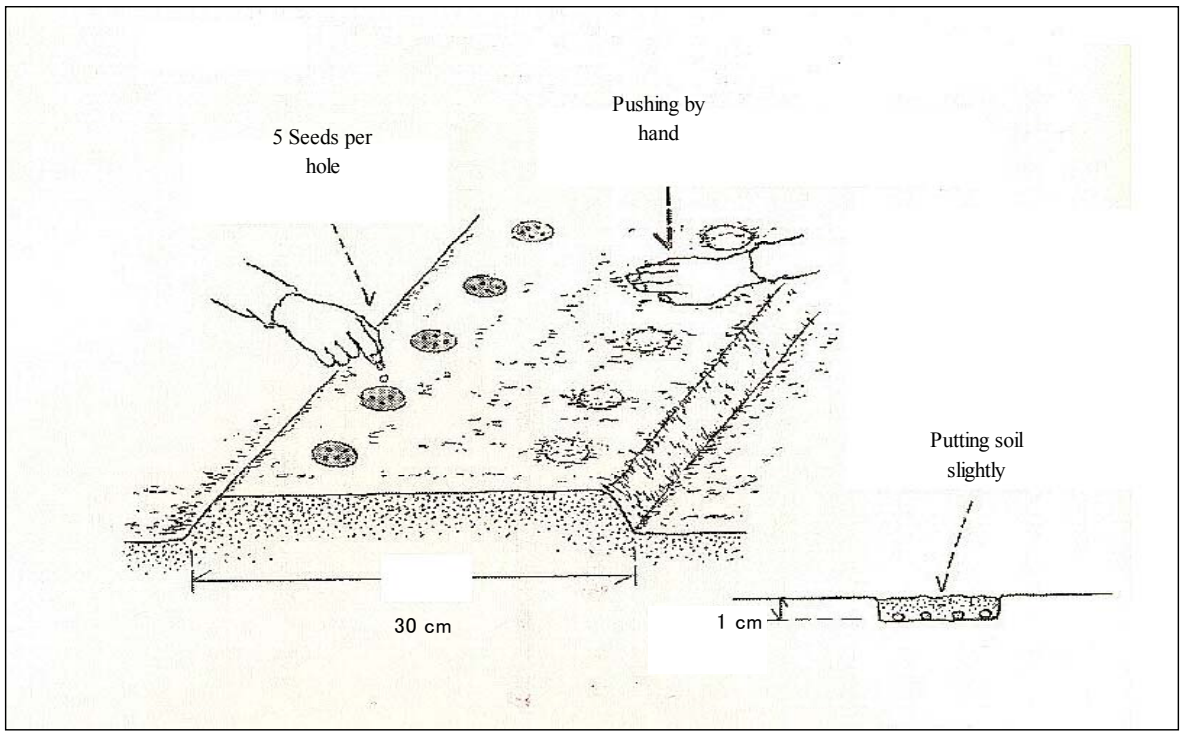
Density: 250000 plants/ha

Double line

Sowing for Carrot

Carrots are always direct seeded. Carrot seed are sown at the rate of 7-8 live seed per small hole. Seed are

most commonly sown in 2 lines in beds 30 cm wide (Please refer to the following figure). Seeds are lightly covered by soil. To avoid competition of taking nutrient amongst the seedlings, thinning is required to reduce density of crops. First time of thinning will be made one month at 2-3 leaves stage. 3 seedlings are left. Second time of thinning will be made at 5-6 leaves stage, only one seedling is left.



Supplemental fertilizer

Around 15 days – 30 days after sowing, the supplemental fertilizer should be applied. Only nitrogen fertilizer will be applied.

N	P2O5	K20	Organize Manure
80 kg/ha	-	-	-

Weed control

Weeds are removed from time to time. Hand weeding and timely shallow cultivation will reduce weed pressure. You can rotate carrots with cover crops or green manure crops or use herbicides to control weeds, if necessary.

(5) Cost and Benefit

Cost based on the verification study in 2004

Inputs Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Seeds			
Carrot	10 kg/ha	130 DH/kg	1,300 DH
Organic Manure	20 ton/ha	120 DH/ton	2,400 DH
Chemical Fertilizer			
14-28-14	600 kg/ha	2.95 DH/kg	1,770 DH
N-Amoni (21%)	500 kg/ha	1.84 DH/kg	920 DH
Agro-Chemicals	1 bottle/ha	40 DH/bottle	40 DH
Tractor	16 hr/ha	60 DH/hr	960 DH
Labor Cost	23 man-day/ha	40 DH/man-day	920 DH
Total Input Cost per ha			8,310 DH

Selling price based on the verification study in December 2004 (DH/kg)

	Ait Ben Omar, Tinejdat	Lambarki, Jorf	Taoumart, Alnif
Average price	1.86	0.52	0.98
Lowest price	0.75	0.40	0.50
Highest price	2.00	2.00	2.00
Remarks	Local market price	Local market and farm gate prices	Local market and farm gate prices

Income based on the verification study in December 2004

Name of Khettara	Irrigation Method	Area	Total Production (kg)	Production per Ha (Kg/ha)	Income at DH 0.5/kg (DH/ha)	Income at Actual Price (DH/ha)
Ait Ben Omar	Drip irrigation	0.08	867	10,800	6,480	15,900
(Tinjdad)	Fallow irrigation with reservoir	0.07	200	2,900	1,740	0
	Fallow irrigation without reservoir	0.04	100	2,500	1,500	0
	Traditional irrigation	0.10	1,045	10,500	6,300	12,600
Lambarkia	Drip irrigation	0.08	3,008	37,600	22,560	20,300
(Jorf)	Fallow irrigation with reservoir	0.07	2,660	38,000	22,800	22,000
	Fallow irrigation without reservoir	0.07	1,232	17,600	10,560	12,700
	Traditional irrigation	0.05	1,186	23,700	14,220	43,700
Taoumart	Fallow irrigation with reservoir	0.07	4,337	62,000	37,200	59,860
(Alnif)	Fallow irrigation without reservoir	0.06	2,419	40,300	24,180	37,900
	Traditional irrigation	0.06	3,273	54,600	32,760	58,400

3.5 Melon

(1) Characteristic

Melon (Cucumis melo L.) in Tafilaet are planted from March through April and harvested from June to July. This crop is very common in Morocco and it is grown in the north, the south and in the inland regions. Melons prefer well-drained soils. Sandy or silt loams are sometimes selected for the melon cultivation. Beds should be left cloddy to allow maturing melons to develop with minimal soil contact and good aeration. To maximize heating for increase of soil temperature, the sun's rays should strike the soil surface at a nearly perpendicular angle. Melon requires strong sunshine. Optimal production temperatures are between 22° and 30°C. These temperatures are ideal ones for vegetative growth, and fruit development.

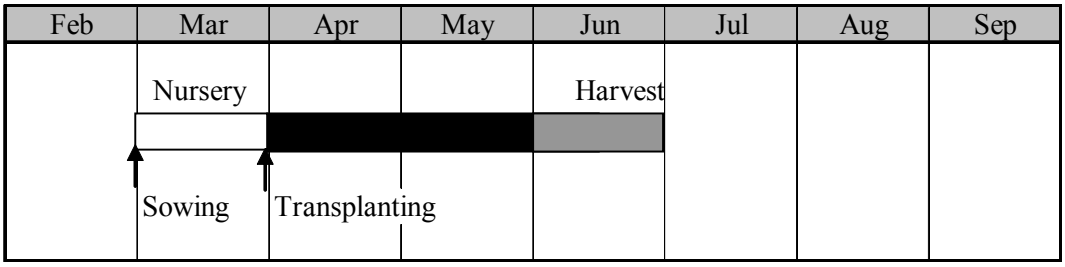
(2) Variety

Melon varieties differ in fruit characteristics, disease resistance, and climatic adaptability. These factors should be carefully considered when selecting varieties for production.

Crops	Variety used in the JICA Study	Others variety
Melon	Souihla de Marrakech	Arrava, Galia , Alma, Gal- Lavi 52,

(3) Cropping Calendar

Growth Period: Around 130 days



Ait Ben Omar

Crop	Irrigation Method	Seeding	Transplanting	Land Preparation	Thinning	Weeding	Pruning	Basic Fertilizer	Supplemental Fertilizer			Harvest	End of Harvest
									First	Second	Third		
Melon	Drip irrigation	2005/3/11	2005/3/31	2005/3/31	2005/6/1-4	2005/04/26 2005/05/20	2005/5/30	2005/3/31	2005/5/15			2005/6/6	2005/7/20
	Fallow irrigation with reservoir	2005/3/11	2005/4/6	2005/3/31	2005/6/4	2005/5/23	2005/5/30	2005/3/31	2005/5/15			2005/6/15	2005/7/20
	Fallow irrigation without reservoir	2005/3/11	2005/4/6	2005/4/4		2005/05/9-23		2005/4/4	2005/5/15			2005/6/12	2005/7/20
	Traditional irrigation	2005/3/11		2005/3/11		2005/04/29 2005/05/11-19		2005/3/11	2005/5/15			2005/6/12	2005/7/20
Lambarkia													
Melon	Drip irrigation	2005/3/3	2005/4/27	2005/3/24	2005/5/13	2005/4/15	2005/5/22	2005/3/24	2005/4/21	2005/5/25	2005/6/6	2005/6/14	2005/7/12
	Fallow irrigation with reservoir	2005/3/3	2005/3/28	2005/3/27	2005/5/18	2005/4/15	2005/5/18	2005/3/27	2005/4/26	2005/5/28	2005/6/7	2005/6/20	2005/7/12
	Fallow irrigation without reservoir	2005/3/3	2005/3/29	2005/3/26	2005/5/25	2005/4/14	2005/5/24	2005/3/26	2005/4/27	2005/5/28	2005/6/7	2005/6/19	2005/7/12
	Traditional irrigation	2005/3/29		2005/3/26	2005/5/2	2005/04/15 2005/05/02	2005/5/25	2005/3/26	2005/4/28	2005/5/28	2005/6/7	2005/6/20	2005/7/12
Taoumarte													
Melon	Fallow irrigation with reservoir	2005/3/9	2005/4/5	2005/4/2	2005/4/12	2005/4/17-30, 2005/05/09	2005/5/30	2005/4/2	2005/4/12	2005/4/22	2005/5/3	2005/6/5	2005/7/18
	Fallow irrigation without reservoir	2005/3/9	2005/4/5	2005/4/2	2005/4/23	2005/4/17-30200 5/5/19-23	2005/5/30	2005/4/2	2005/4/12	2005/5/3	2005/5/26	2005/6/5	2005/7/18
	Traditional irrigation	2005/3/12		2005/3/10	2005/4/19-12	2005/4/2 01/05/2005		2005/3/10	2005/4/15	2005/4/24	2005/5/20	2005/6/12	2005/7/18

(4) Cultivation methodology

Nursery preparation

Seedlings of melon will be prepared through nursery preparation as shown in page 3-3. The melon seedlings are sensitive to cold temperature and, therefore, careful maintenance of nursery using small plastic houses is required.

Preparatory work

Basic fertilizer and organic manure are applied in the bottom of beds.

N	P2O5	K20	Organize Manure
50 kg/ha	120 kg/ha	120 kg/ha	20 ton/ha

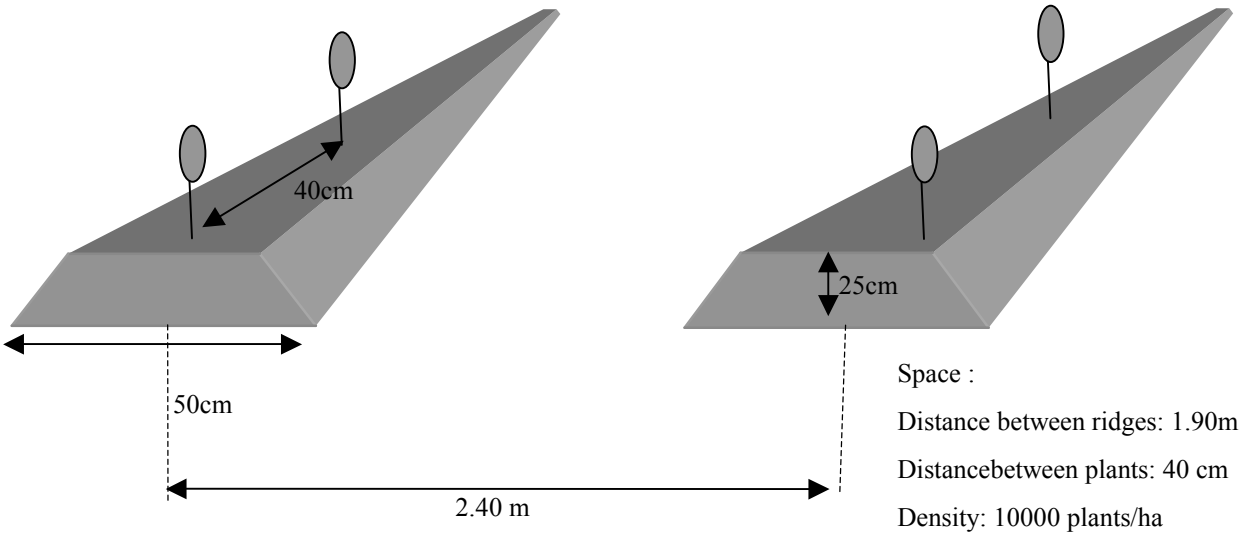
Spacing

Seed: 2.5 – 3.5 kg/ha

Seedlings: 10,000 seedlings/ha

Density:

Drip Irrigation



Space :

Distance between ridges: 1.90m

Distancebetween plants: 40 cm

Density: 10000 plants/ha

Ligne simple

Furrow Irrigation

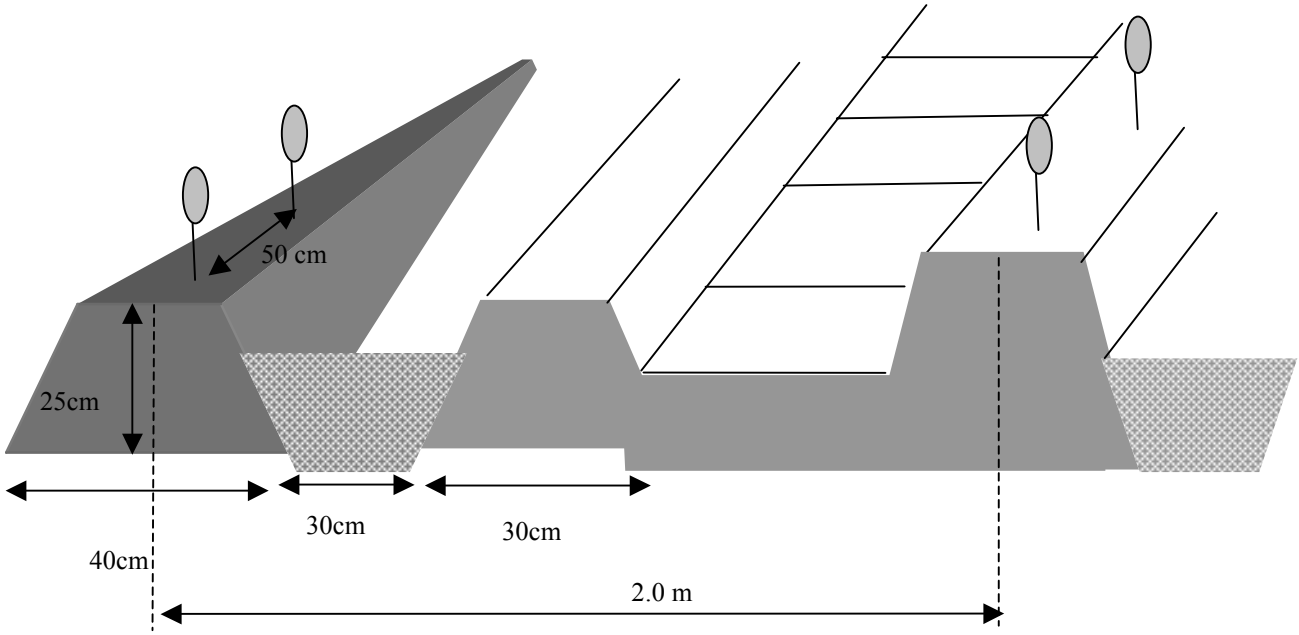
Space:

Distance between ridges: 2m

Distance between plants: 50 cm

Density: 10000 plants/ha

Ligne simple



Supplemental fertilizer

Around 30 days after seedling, the first supplemental fertilizer should be applied. Then, the second and third supplemental fertilizer will be applied as required.

N	P2O5	K20	Organize Manure
200 kg/ha	55 kg/ha	200 kg/ha	-

Maintenance of Melon

Replacement of seedling to new seedling should be made if disease or poor growth seedlings were identified. To avoid competition of taking nutrient amongst the seedlings, thinning is required to reduce density of crops. The thinning will be made one month at 4 leaves stage. Removing non-healthy and diseased leaves should be made from time to time, since those leaves increase disease risks.

(5) Cost and Benefit

Cost based on the verification study in 2005

Inputs Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Seeds			
Melon	5.7 kg/ha	800 DH/kg	4,560 DH
Nursery Preparation			
Plates	151 nos/ha	9.5 DH/kg	1,430 DH
Peat	24 bag/ha	150 DH/kg	3,600 DH
Plastic sheet	21 m2/ha	25 DH/m2	530 DH
Organic Manure	11.8 ton/ha	120 DH/ton	1,420 DH
Chemical Fertilizer			
14-28-14 (For basic ertilizer)	592 kg/ha	3.25 DH/kg	1,920 DH
14-28-14	426 kg/ha	3.25 DH/kg	1,380 DH
N-Amoni (33%)	149 kg/ha	3.0 DH/kg	450 DH
K-Sulfate (50%)	184 kg/ha	4.0 DH/kg	740 DH
Agro-Chemicals	11.1 bottle/ha	40 DH/bottle	440 DH
Tractor	3.7 hr/ha	60 DH/hr	220 DH
Labor Cost	79.9 man-day/ha	40 DH/man-day	3,200 DH
Total Input Cost per ha			19,890 DH

Selling price based on the verification study in June 2005 (DH/kg)

	Ait Ben Omar, Tinejdat	Lambarki, Jorf	Taoumart, Alnif
Average price	2.30	2.90	3.00

Income based on the verification study in June 2005

Name of Khettara	Irrigation Method	Area	Total Production (kg)	Production per Ha (Kg/ha)	Income at DH 15/kg (DH/ha)	Income at Actual Price (DH/ha)
Ait Ben Omar	Drip irrigation	0.090	937	10,400	26,000	25,100
(Tinjdad)	Fallow irrigation with reservoir	0.063	575	9,100	22,750	6,151
	Fallow irrigation without reservoir	0.048	280	5,800	14,500	7,531
	Traditional irrigation	0.125	612	4,900	12,250	4,478
Lambarkia	Drip irrigation	0.035	544	15,500	38,750	43,804
(Jorf)	Fallow irrigation with reservoir	0.025	309	12,400	31,000	32,846
	Fallow irrigation without reservoir	0.041	308	7,500	18,750	19,420
	Traditional irrigation	0.013	147	11,300	28,250	28,843
Taoumart	Fallow irrigation with reservoir	0.019	961	50,600	126,500	141,969
(Alnif)	Fallow irrigation without reservoir	0.039	379	9,700	24,250	16,954
	Traditional irrigation	0.024	225	9,400	23,500	25,188

3.6 Watermelon

(1) Characteristic

Watermelon (Citrullus lanatus) in Tafilaet are planted from April to early July for harvest from mid-May to late October. This crop is very common in Morocco and it is grown in the north, the south and in the inland regions. Watermelons grow best on non-saline sandy loam or silt loam soils. Some can be grown on dune sand when given adequate irrigation water and fertilizer, since watermelon indicates strong resistance against drought. Optimal production temperatures are between 25° and 30°C. These temperatures are ideal ones for vegetative growth, and fruit development.

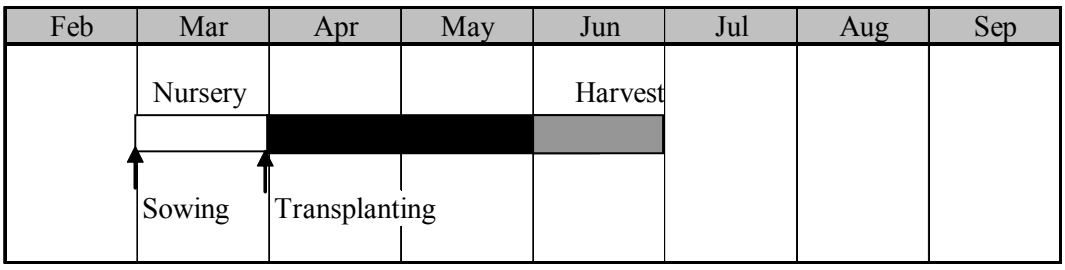
(2) Variety

Watermelon varieties differ in fruit characteristics, disease resistance, and climatic adaptability. These factors should be carefully considered when selecting varieties for production.

Crops	Variety used in the JICA Study	Others variety
Watermelon	Sweet Crimson	Mirage, Sangria, Fiesta,

(3) Cropping Calendar

Growth Period: Around 130 days



Lambarkia

Crop	Irrigation Method	Seeding	Transplanting	Land Preparation	Thinning	Weeding	Pruning	Basic Fertilizer	Supplemental Fertilizer			Harvest	End of Harvest
									First	Second	Third		
Watermelon	Drip irrigation	2005/3/3	2005/3/28	2005/3/24	2005/5/13	2005/4/15	2005/5/13	2005/3/24	2005/4/21			2005/5/29	2005/7/5
	Fallow irrigation with reservoir	2005/3/3	2005/3/28	2005/3/27	2005/5/27	2005/4/14	2005/5/27	2005/3/27	2005/4/28			2005/6/21	2005/7/5
	Fallow irrigation without reservoir	2005/3/3	2005/3/29	2005/3/26	2005/5/27	2005/4/14	2005/5/2	2005/3/26	2005/4/27			2005/6/16	2005/7/5
	Traditional irrigation	2005/3/26		2005/3/25	2005/5/12	2005/5/2		2005/3/24	2005/4/28			2005/6/27	2005/7/5
Taoumarte													
Watermelon	Fallow irrigation with reservoir	2005/3/9	2005/4/6	2005/4/5	2005/4/12	2005/5/1		2005/4/5	2005/5/21			2005/6/8	2005/7/12
	Fallow irrigation without reservoir	2005/3/9	2005/3/30	2005/3/29	2005/4/10	2005/04/16, 2005/05/10		2005/3/26	2005/5/24			2005/6/8	2005/7/12
	Traditional irrigation	2005/3/12		2005/2/20	2005/4/12-19	2005/5/1		2005/3/8	2005/5/23			2005/6/12	2005/7/12

(4) Cultivation methodology

Nursery preparation

Seedlings of watermelon will be prepared through nursery preparation as shown in page 3-3. The watermelon seedlings are sensitive to cold temperature and, therefore, careful maintenance of nursery using small plastic houses is required.

Preparatory work

Basic fertilizer and organic manure are applied in the bottom of beds.

N	P2O5	K20	Organize Manure
60 kg/ha	120 kg/ha	80 kg/ha	20 ton/ha

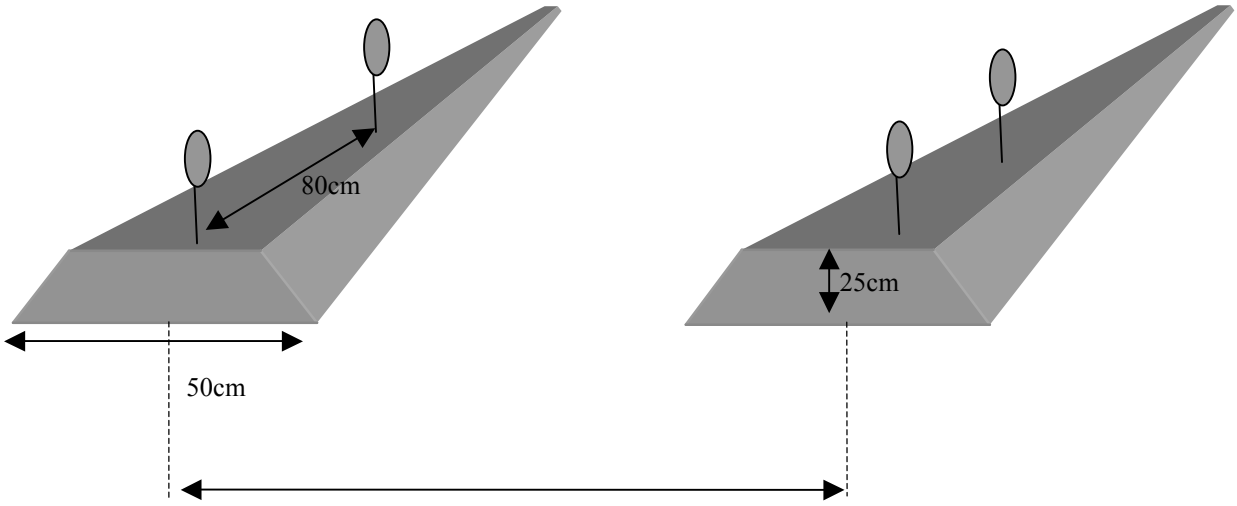
Spacing

Seed: 3.0 – 3.5 kg/ha

Seedlings: 5,000 seedlings/ha

Density:

Drip Irrigation



Space :

Distance between ridges : 1.90m

Distance between plants: 80 cm

Density: 5000 plants/ha

Ligne simple

Furrow Irrigation

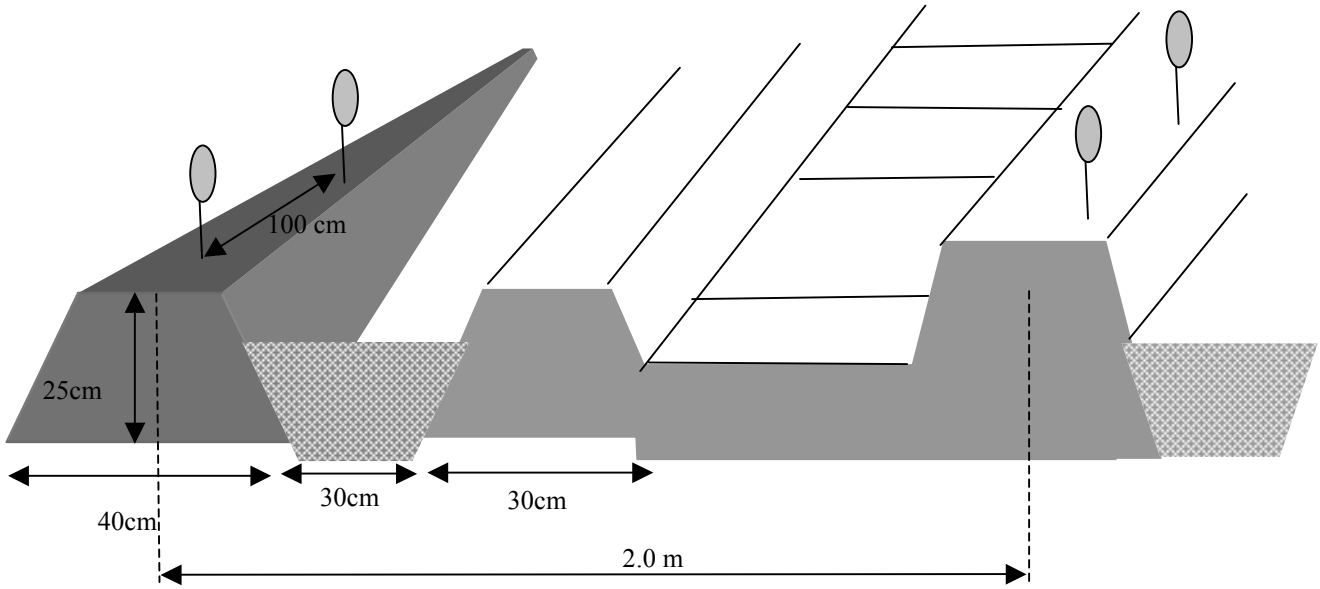
Space:

Distance between ridges: 2m

Distance between plants: 100 cm

Density: 5000 plants/ha

Ligne simple



Supplemental fertilizer

Around 30 days after seedling, the first supplemental fertilizer should be applied.

N	P2O5	K20	Organize Manure
20 kg/ha	40 kg/ha	10 kg/ha	-

Maintenance of Watermelon

Replacement of seedling to new seedling should be made if disease or poor growth seedlings were identified. To avoid competition of taking nutrient amongst the seedlings, thinning is required to reduce density of crops. The thinning will be made one month at 4 leaves stage. Removing non-healthy and diseased leaves should be made from time to time, since those leaves increase disease risks.

(5) Cost and Benefit

Cost based on the verification study in 2005

Inputs Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Seeds			
Watermelon	6.1 kg/ha	800 DH/kg	2,500 DH
Nursery Preparation			
Plates	135 nos/ha	9.5 DH/kg	1,280 DH
Peat	22 bag/ha	150 DH/kg	3,300 DH
Plastic sheet	22 m2/ha	25 DH/m2	550 DH
Organic Manure	22.4 ton/ha	120 DH/ton	2,690 DH
Chemical Fertilizer			
14-28-14 (For basic ertilizer)	574 kg/ha	3.25 DH/kg	1,870 DH
14-28-14	143 kg/ha	3.25 DH/kg	460 DH
N-Amoni (33%)	0 kg/ha	3.0 DH/kg	0 DH
K-Sulfate (50%)	0 kg/ha	4.0 DH/kg	0 DH
Agro-Chemicals	4 bottle/ha	40 DH/bottle	160 DH
Tractor	3.7 hr/ha	60 DH/hr	220 DH
Labor Cost	86.3 man-day/ha	40 DH/man-day	3,450 DH
Total Input Cost per ha			16,480 DH

Selling price based on the verification study in June 2005 (DH/kg)

	Ait Ben Omar, Tinejdat	Lambarki, Jorf	Taoumart, Alnif
Average price	-	2.01	1.96

Income based on the verification study in June 2005

Name of Khettara	Irrigation Method	Area	Total Production (kg)	Production per Ha (Kg/ha)	Income at DH 15/kg (DH/ha)	Income at Actual Price (DH/ha)
Lambarkia	Drip irrigation	0.036	714	19,800	39,600	32,423
(Jorf)	Fallow irrigation with reservoir	0.028	557	19,900	39,800	38,799
	Fallow irrigation without reservoir	0.020	383	19,200	38,400	40,099
	Traditional irrigation	0.015	269	17,900	35,800	31,172
Taoumart	Fallow irrigation with reservoir	0.072	1,649	22,900	45,800	32,497
(Alnif)	Fallow irrigation without reservoir	0.050	700	14,000	28,000	16,962
	Traditional irrigation	0.026	458	17,600	35,200	29,922

3.7 Tomato

(1) Characteristic

Tomato (Lycopersicon esculentum) in Tafilaet are planted from March through April and harvested from July to September. Tomato is a warm-season vegetable crop that is sensitive to frost at any stage of growth. The optimum soil temperature for seed germination is 20°C or above and seed germination below 16°C is very slow. Optimal production temperatures are between 21° and 27°C. These temperatures are ideal ones for vegetative growth, and fruit development. Tomato needs the strong sunshine and, therefore, plant distance should be carefully considered and maintained. Tomato indicates relatively high resistance against drought. Tomato can be grown on poles, while tomato has been cultivated as bush type in the traditional way. This practice with poles greatly increases total production costs but increased yields.

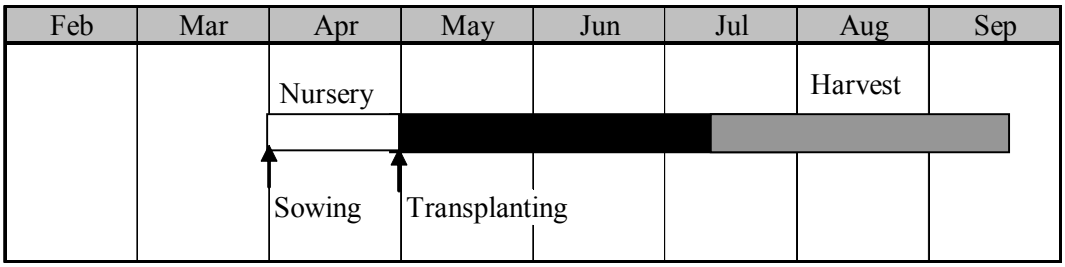
(2) Variety

Tomato varieties differ in fruit characteristics, disease resistance, and climatic adaptability. These factors should be carefully considered when selecting varieties for production.

Crops	Variety used in the JICA Study	Others variety
Tomato	Saint pierre	Casque rouge, Marglob, Montfavet,

(3) Cropping Calendar

Growth Period: Around 140-160 days



Ait Ben Omar

Crop	Irrigation Method	Seeding	Transplanting	Land Preparation	Weeding	Pruning	Basic Fertilizer	Supplemental Fertilizer			Begging of Harvest	End of Harvest
								First	Second	Third		
Tomate	Drip irrigation	2005/3/28	2005/5/24	2005/4/18	2005/04/29, 2005/05/9-23	2005/5/5	2005/4/18	2005/5/15			2005/6/20	2005/8/15
	Fallow irrigation with reservoir	2005/3/28	2005/05/15-26	2005/4/26	2005/5/23	2005/6/2	2005/4/26	2005/5/15			2005/6/25	2005/8/15
	Fallow irrigation without reservoir	2005/3/28	2005/5/1	2005/4/27	2005/05/19-23		2005/4/27	2005/5/15			2005/6/25	2005/8/15
	Traditional irrigation	2005/3/11		2005/3/11	2005/05/11-19		2005/4/27	2005/5/15			2005/6/25	2005/8/15
Lambarkia												
Tomato	Drip irrigation	2005/3/28	2005/4/17	2005/3/24	2005/5/2-5	2005/5/23	2005/3/24	2005/5/25	2005/7/1		2005/6/25	2005/9/10
	Fallow irrigation with reservoir	2005/3/28	2005/4/19	2005/4/18	2005/05/2-20	2005/5/26	2005/4/18	2005/5/28	2005/7/1		2005/7/4	2005/9/10
	Fallow irrigation without reservoir	2005/3/28	2005/4/11	2005/4/6	2005/05/2-16	2005/5/26	2005/4/6	2005/5/28	2005/7/1		2005/7/4	2005/9/10
	Traditional irrigation	2005/4/11		2005/4/6	2005/05/2-19	2005/5/26	2005/4/6	2005/5/28	2005/7/1		2005/7/4	2005/9/10
Taoumarte												
Tomato	Fallow irrigation with reservoir	2005/3/9	2005/4/7	2005/4/3	2005/4/20-30 ,18 -22-24-31/05/20 05	2005/6/3	2005/4/5	2005/5/12	2005/6/22		2005/5/31	2005/8/15
	Fallow irrigation without reservoir	2005/3/9	2005/4/7	2005/4/3	2005/5/19-23	2005/5/24-25	2005/4/3	2005/5/3	2005/6/26		2005/5/31	2005/8/15
	Traditional irrigation	2005/3/15	2005/4/15	2005/4/15	2005/04/30, 2005/05/1	2005/5/21	2005/4/15	2005/5/14	2005/6/10		2005/6/15	2005/8/15

(4) Cultivation methodology

Nursery preparation

Seedlings of tomato will be prepared through nursery preparation as shown in page 3-3. The tomato seedlings are sensitive to frost and, therefore, careful maintenance of nursery using small plastic houses is required.

Preparatory work

Basic fertilizer and organic manure are applied in the bottom of beds.

N	P2O5	K20	Organize Manure
50 kg/ha	120 kg/ha	120 kg/ha	20 ton/ha

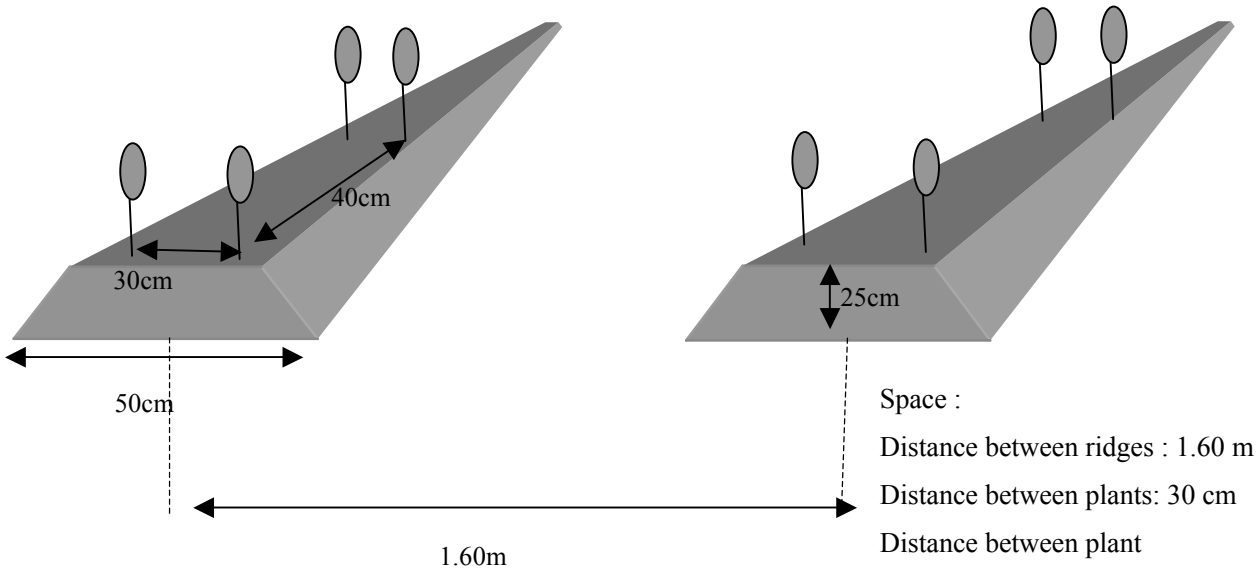
Spacing

Seed: 0.10 – 0.15 kg/ha

Seedlings: 28,000 – 33,000 seedlings/ha

Density:

Drip Irrigation



Space :
Distance between ridges : 1.60 m
Distance between plants: 30 cm
Distance between plant
on the same ligne: 40 cm
Density: 31,250 plants/ha
Double Line

Furrow Irrigation

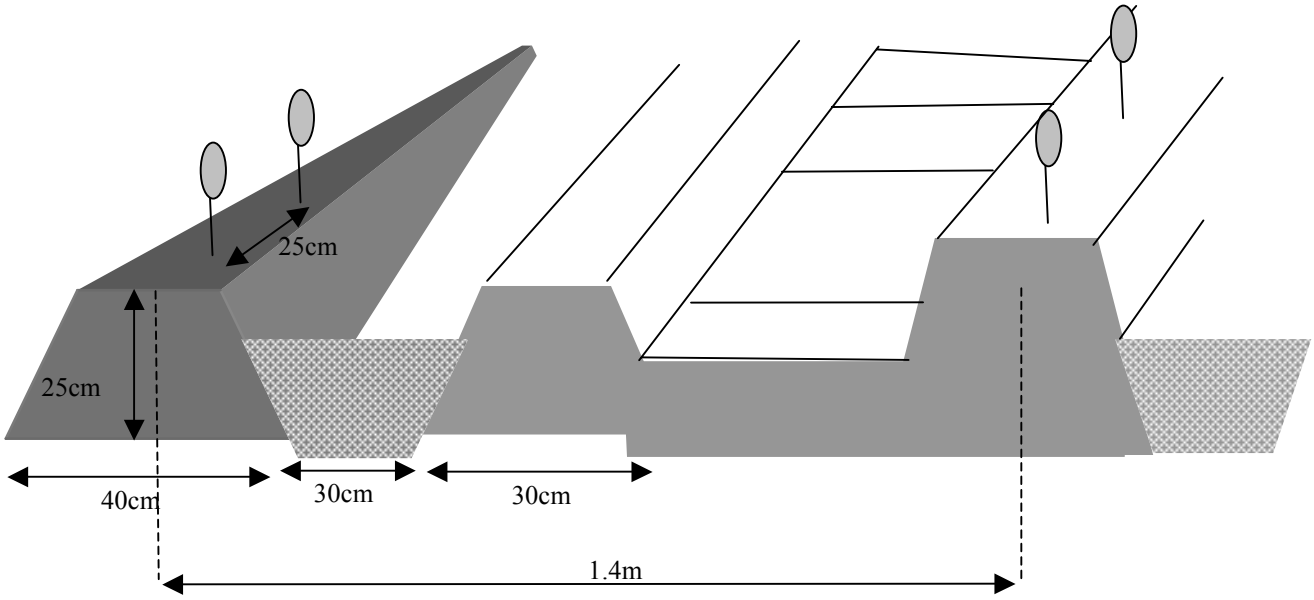
Space:

Distance between ridges: 1.4m

Distance between plants: 25 cm

Density: 28,7500 plants/ha

Line Single



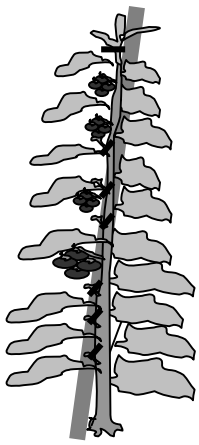
Supplemental fertilizer

Around 30 days after seedling, the first supplemental fertilizer should be applied. Then, the second supplemental fertilizer will be applied as required.

N	P2O5	K20	Organize Manure
70 kg/ha	60 kg/ha	120 kg/ha	-

Maintenance of Tomato

Poles are placed between every plants and additional pole should be attached for reinforce. An wire is stapled to the poles and anchored at row ends. Plants are pruned to one shoot below the each flower cluster as shown in the figure. In addition, the four – six flower clusters are developed, the top of main shoot will be pruned. In order to increase pollination and fruit set, tying is done in the dry time of the day for added vibration of flowers when pollen is less sticky.



(5) Cost and Benefit

Cost based on the verification study in 2005

Inputs Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Seeds			
Tomato	0.4 kg/ha	1,400 DH/kg	560 DH
Nursery Preparation			
Plates	151 nos/ha	9.5 DH/kg	1,430 DH
Peat	24 bag/ha	150 DH/kg	3,600 DH
Plastic sheet	21 m2/ha	25 DH/m2	530 DH
Organic Manure	11.8 ton/ha	120 DH/ton	1,420 DH
Chemical Fertilizer			
14-28-14 (For basic fertilizer)	592 kg/ha	3.25 DH/kg	1,920 DH
14-28-14	426 kg/ha	3.25 DH/kg	1,380 DH
N-Amoni (33%)	149 kg/ha	3.0 DH/kg	450 DH
K-Sulfate (50%)	184 kg/ha	4.0 DH/kg	740 DH
Agro-Chemicals	11.1 bottle/ha	40 DH/bottle	440 DH
Banboo	1 set/ha	1700 DH/set	1,700 DH
Tractor	3.7 hr/ha	60 DH/hr	220 DH
Labor Cost	79.9 man-day/ha	40 DH/man-day	3,200 DH
Total Input Cost per ha			17,590 DH

Selling price based on the verification study in June 2005 (DH/kg)

	Ait Ben Omar, Tinejdat	Lambarki, Jorf	Taoumart, Alnif
Average price	2.30	1.96	2.00

Income based on the verification study in June 2005

Name of Khettara	Irrigation Method	Area	Total Production (kg)	Production per Ha (Kg/ha)	Income at DH 15/kg (DH/ha)	Income at Actual Price (DH/ha)
Ait Ben Omar	Drip irrigation	0.063	3,167	50,300	75,450	67,959
(Tinjdad)	Fallow irrigation with reservoir	0.037	1,512	40,900	61,350	64,171
	Fallow irrigation without reservoir	0.043	648	15,100	22,650	28,037
	Traditional irrigation	0.047	324	6,900	10,350	12,793
Lambarkia	Drip irrigation	0.025	1,467	58,700	88,050	105,906
(Jorf)	Fallow irrigation with reservoir	0.026	751	28,900	43,350	53,333
	Fallow irrigation without reservoir	0.022	607	27,600	41,400	40,000
	Traditional irrigation	0.012	114	9,500	14,250	16,134
Taoumart	Fallow irrigation with reservoir	0.023	907	39,400	59,100	71,762
(Alnif)	Fallow irrigation without reservoir	0.013	384	29,500	44,250	54,800
	Traditional irrigation	0.024	382	15,900	23,850	28,066

3.8 Gumbo

(1) Characteristic

Gumbo (Abelmoschus esculentus L) in Tafilaet are planted from March through April and harvested from July to October. Gumbo is very popular for food in Morocco. Therefore, it is important cash crop for small-scale farmers. Gumbo is a hot-season vegetable crop that is high tolerance to high temperature at any stage of growth. Soil temperature should be at least 16°C for adequate germination. Optimal production temperatures are between 25° and 30°C in day time. These temperatures are ideal ones for vegetative growth, and fruit development.

The gumbo indicates relatively high resistance against drought, while it is sensitive to submerged water under the poor drainage condition. Gumbo needs the strong sunshine and, therefore, leave pruning should be made from time to time.

(2) Variety

Gumbo has many varieties including F1 variety. However, local variety was applied in the verification study, since local people prefers the taste of local variety.

Crops	Variety used in the JICA Study	Others variety
Gumbo	Local variety	Emerald, Clemson spinelss

(3) Cropping Calendar

Growth Period: Around 120 days

Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
				Harvest			
	Sowing						

Crop	Irrigation Method	Seeding	Transplanting	Land Preparation	Weeding	Pruning	Basic Fertilizer	Supplemental Fertilizer			Begging of Harvest	End of Harvest
								First	Second	Third		
Lambarkia												
Gumbo	Drip irrigation	2005/3/4		2005/3/3	2005/4/28	2005/4/15	2005/4/22	2005/3/3			2005/6/2	2005/7/22
	Fallow irrigation with reservoir	2005/3/2		2005/3/2	2005/5/23	2005/04/14 2005/05/02	2005/5/23	2005/3/2			2005/5/27	2005/7/22
	Fallow irrigation without reservoir	2005/3/4		2005/3/3	2005/5/26	2005/4/15	2005/5/23	2005/3/3			2005/5/19	2005/7/22
	Traditional irrigation	2005/3/4		2005/3/3	2005/5/26	2005/04/15 2005/05/02	2005/5/27	2005/3/5			2005/5/20	2005/7/22
Taoumarte												
Gumbo	Fallow irrigation with reservoir	2005/3/10		2005/3/9	2005/4/12	2005/04/2-8	2005/5/25	2005/3/9			2005/6/12	2005/8/14
	Fallow irrigation without reservoir	2005/3/4		2005/3/4	2005/4/10	2005/4/4, 2005/5/9	2005/4/21-23	2005/3/3			2005/5/27	2005/8/14
	Traditional irrigation	2005/3/10		2005/3/9	2005/4/12-19	2005/04/2 2005/05/1	2005/5/20	2005/3/5			2005/5/20	2005/8/14

(4) Cultivation methodology

Preparatory work

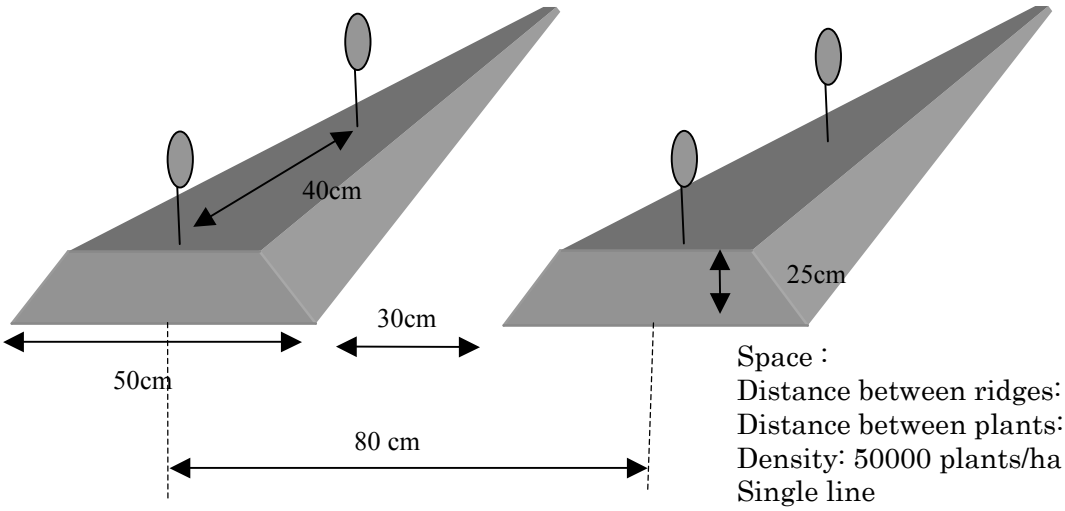
To avoid weeds, initial nitrogen application to gumbo should be limited to only 40 kg/ha. Basic fertilizer and organic manure are applied in the bottom of beds.

N	P2O5	K20	Organize Manure
40 kg/ha	80 kg/ha	40 kg/ha	20 ton/ha

Spacing

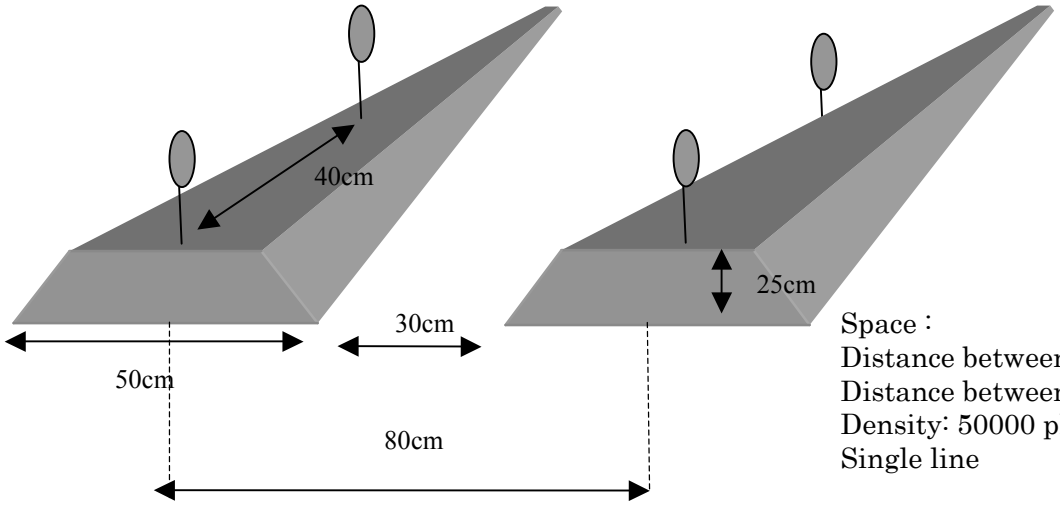
Seed: 25 kg/ha
Seedlings: 20,000 – 22,000 seedlings/ha
Density:

Drip Irrigation



Space :
Distance between ridges: 80cm
Distance between plants: 25 cm
Density: 50000 plants/ha
Single line

Furrow Irrigation



Space :
Distance between ridges : 80cm
Distance between plants: 25 cm
Density: 50000 plants/ha
Single line

Supplemental fertilizer

Around 30 days after seedling, the first supplemental fertilizer should be applied.

N	P2O5	K20	Organize Manure
20 kg/ha	30 kg/ha	20 kg/ha	-

Maintenance of Gumbo

Weeds are removed from time to time. At early-stage in the cultivation, weed control should be shallow so as not to injure young okra roots. Hand weeding and timely shallow cultivation will reduce weed pressure. You can rotate turnips with cover crops or green manure crops or use herbicides to control weeds, if necessary. Harvesting is done by hand. Okra is harvested every 2 to 3 days or more often under very warm conditions. The crop is ready for harvest about 4 to 6 days after flowering, when the pods reach 7.5–12.5 cm long.

(5) Cost and Benefit

Cost based on the verification study in 2005

Inputs Cost	Volume for One Ha	Unit Price	Unit Cost per Ha
Seeds			
Tomato	40.2 kg/ha	1,400 DH/kg	2,010 DH
Organic Manure	11.8 ton/ha	120 DH/ton	1,420 DH
Chemical Fertilizer			
14-28-14 (For basic fertilizer)	603 kg/ha	3.25 DH/kg	1,960 DH
14-28-14	141 kg/ha	3.25 DH/kg	460 DH
N-Amoni (33%)	0 kg/ha	3.0 DH/kg	0 DH
K-Sulfate (50%)	0 kg/ha	4.0 DH/kg	0 DH
Agro-Chemicals	8 bottle/ha	40 DH/bottle	320 DH
Tractor	3.7 hr/ha	60 DH/hr	220 DH
Labor Cost	86.0 man-day/ha	40 DH/man-day	3,440 DH
Total Input Cost per ha			9,830 DH

Selling price based on the verification study in June 2005 (DH/kg)

	Ait Ben Omar, Tinejdat	Lambarki, Jorf	Taoumart, Alnif
Average price	-	5.50	5.35

Income based on the verification study in June 2005

Name of Khettara	Irrigation Method	Area	Total Production (kg)	Production per Ha (Kg/ha)	Income at DH 15/kg (DH/ha)	Income at Actual Price (DH/ha)
Lambarkia	Drip irrigation	0.047	2,165	46,100	230,500	209,597
(Jorf)	Fallow irrigation with reservoir	0.037	916	24,800	124,000	132,514
	Fallow irrigation without reservoir	0.035	1,050	30,000	150,000	162,609
	Traditional irrigation	0.013	126	9,700	48,500	42,366
Taoumart	Fallow irrigation with reservoir	0.028	1,189	42,500	212,500	154,486
(Alnif)	Fallow irrigation without reservoir	0.037	406	11,000	55,000	53,231
	Traditional irrigation	0.052	309	5,900	29,500	48,000

3.9 Disease identified in the verification study

Disease or insect	Crops	farm	Characteristics	Product name	Active ingredient	Photo
Rot of beet crown	- Tomato	- Ait Ben Omar - Lambarkia	- Grey roots, central cylinder and veins situated at the central branch.; -Grey canker, lightly depressed which develop in one side of the stem like flames; -high leaves are fallen before low ones and there is a yellow or a golden colour.	- Pelt 44	Methoxycarbonyl -thiocarbamoylamino	 **- Rot of beet crown on Tomato**
Blossom end rot	- Tomato	- Ait Ben Omar - Lambarkia - Taoumart	Apical Necrosis: It is presented on the basic extremity of the fruits in the form of necrotic marks ; it is due to the excess of Azote and salinity also to the shortage of calcium and irregular irrigation **(hydrological stress)** and to antagonism effect of K, Mg and NH on Calcium.	- oxicalc	- oxyde of calcium	 **- Blossom end rot on Tomate (Taoumart)**
Tomato blight	- Tomato	- Taoumart	**Scietific name** : *Phytophthora infestans* **Common name :** Mildiou - Early crops get some grey marks. Late attacks have more homogenous marks very often in concentric circles.	- Pelt 44	Methoxycarbonyl -thiocarbamoylamino	 **- Tomato blight symptom**

Aphid	- Gombo - Watermelon - Tomato	- Ait Ben Omar - Lambarkia - Taoumart	**Vernacular Name:** pucerons verts **Taxonomic position**: *Myzus persicae* Attacks the basic part of leaves which cause their curving, and death.	- Decis 25 EC - Perimor 50 DG	-Deltamethrine -Pyrimicarbe	 **- dammage of Aphid on Tomato.....(Lambarkia)**  **- Aphid Dammage on Gombo (Lambarkia)**
Caterpillar	- Tomato	- Taoumart - Lambarkia	Grey ou green cheniles remain during all their cycle in the upper portion of the plant and cause damage leaves and crops.	- Decis 25 EC	-Deltamethrine	 **- Caterpillar dammage (Taoumart)**

3.10 Caper Plant

(1) Characteristics

The caper plant (capparis Spinoza) is a Mediterranean plant (Morocco, Spain and Italy) and saharo-sindien, shrubby and long-lived. It is spontaneous (Errachidia, Taounate, Marrakech, Safi) and traditionally cultivated for its floral buttons (caper) in three areas in Morocco: Taza, Oued Amlil, Taounate, Safi and Taroudant. Morocco is a large caper producer and exporter in the Mediterranean basin and the world.

The caper plant (c.spinosa) of the vernacular names (Kebbar, Taylalout, Tayloulout) belongs to the family of **Capparidacy** (**Capparidacée)** and **Capparis** kind which contains more than 350 species. It is a shrub which presents a short trunk with several branches characterized by an ascending aspect, a green color (caper plant of Errachidia) or reddish (caper plant of Taounate) and the presence of stipular spines.

The leaves generally have oval forms with to round with a great variability between individuals relating to the length of the petiole like on the width and the shape of limb. With the adulthood, the shrub measures 50 to 80 cm in height and 1 to 1.5 m in width.

The flowers have a colour white-rose, with four sepals, 4 petals and several stamens grouped in tufts. The fruit is a bay of 4 to 5 cm length, ovoid form and a green colour at the beginning of the growth and reddish with maturity. The number of grains per fruit is on average 150 to 400 grains. The roots are ramified little and very deep.

The development of the branches is characterized by two phases, a first phase of vegetative growth during which there is no floral initiation and second phase which begins once that the branch forms ten nodes and during which one attends the initiation of the floral buttons. Only the final part of the branches initiates the floral buds. As long as they are not open, these floral buds, also called capers, constitute the part of the most required plant for human consumption. A branch of caper plant of Tafilalet contains 8 to 15 capers. A caper weighs surroundings 0.20 - 0.30 gr.

(2) Variety

The varieties most cultivated in the Mediterranean are: Spinoza, Inermes, Parviflora, Aegyptia, Arvensis, Pubescence. The difference between the varieties relates to the forms and dimensions of the leaves, the color of the trunks and the form of the floral buttons. In Tafilalet, one finds the species Capparis Spinoza, Spinoza variety.

(3) Ecological Aspect

The caper plant (C. spinoza) is a xerophytic plant which shows morphological and physiological characteristics enabling him to tolerate the climatic conditions of the arid and semi arid regions. In Morocco it is met in several areas going from the costal areas to the continental zones with more than 1000 m of altitude: Errachidia, Taza, Oued Amlil, Taounate, Safi and Taroudant. Its requirements in temperature are rather broad; one meets it even in the zones or the low temperature reach very low levels in the following table.

Climate Characteristics of Caper Zones in Morocco

Regions	T° max °C	T° min °C	Rainfall mm	Type of Climat
Fès	30.2	6	550	Semi arid with moderated winter
Marrakech	35.5	10.2	270	Arid with soft winter
Safi	22	12	350	Semi arid with hot winter
Tiznit	33.3	7.3	189	Arid with hot winter
Tafilalet	38 - 40	-5 - 7	150 - 200	Arid with cold winter

As for the rainfall, the zones of the caper plant receive on average 200 to 550 mm. It should be noted that towards the south, it is especially limited to the coastal zone on the mouths of rivers which give directly on the sea (case the Aglou River). In these sites, which generally are very been windy, the caper plant tolerates perfectly the winds marine charged with salts, which means that the caper plant must also express a certain tolerance with salinity, this aspect was not yet the subject of study in Morocco.

The caper plant seems to prefer the light soil, well draining with a neutral pH with alkaline. In Safi and in the neighbouring areas one it on muddy sandy light soils with alkaline pH (6 to 9). In the area of Fes, one meets it on Argillaceous Hamri soil and little draining. The analysis of certain samples of ground taken on natural sites and traditional exploitation showed that the grounds of the caper fields are low in biogenic salts and fairly rich in organic matter. They are also fertilise soils in limestone and with alkaline pH. It is frequent to meet caper plants on rocks heterogeneous almost exclusively (more than 90 % of total limestone). In the area of Errachidia, the caper plant is fixed and developed even on the rocks.

(4) Management of Crops

The caper plant is a very old practice in the Mediterranean countries. Italian was the first to be spoken about the culture of the caper knew it about the 17th century. As for the Spaniards, it is in 1875 that they had begun the production and export of capers towards France and some other countries of the Latin

America. In Morocco, the collection of capers and their exports on the French market started about 1920. The oldest traditional plantations of the caper plant are in the area of Taounate, Safi and Taroudant.

Morocco is currently the first producer and exporter of capers in the world. The Moroccan varieties are currently the subject of several agronomic studies. The traditional culture of the caper plant is very simple, it requires only few interventions. The three principal operations which require an investment and minimum of technical training are the propagation plantation, the size and harvest. These two operations practically do not cause problems for the traditional farmers, only the propagation is still badly controlled.

The latter to be done in several ways according to the means of the farmers and their officials of modern technology. In Tafilalet, the culture of caper plant did not have the occasion yet to develop, the experiment undertaken by the laboratory of valorisation and safeguarding of the aromatic and medicinal plants (and technology Faculty of Science of Errachidia) within the framework of this expertise, remains the only attempt of production and propagation of the caper plant.

There exist several modes of multiplication of the caper plant: sowing, the propagation by cutting, grafting and culture in vitro. A comparative study showing the advantages and the disadvantages of the principal techniques as their possibility of application by the farmers of the Tafilalet area is developed in the following table.

Type of production	Advantages	Inconvenient
Sowing Very much used by farmers in Morocco Praticable in Tafilalet	- Requirement of little technicality -Facility of handling of seeds -No obstruction in the conservation and transportation of seeds -Weak duration of production -Great manufacturing unit -Very low production cost	-Feeble % of germination -Problem of variability of clones
Propagation by cutting Not so much used by farmers in Morocco Praticable in Tafilalet	-No variability of clone -Low production cost -To practise only in autumn	-Small manufacturing unit -Feeble % of rooting -Variability in the % of rooting -Technique less simple than sowing
Grafting Not practised by farmers in Morocco	-Great possibility of grafting -Availability of under stocks -Weak duration of production	-Technique with limited application -High production cost.
Culture in vitro Practised only in research at laboratory in Morocco	-Great manufacturing unit -The fastest technique -Effective for selection of clones -Hygienic technique -To practise all the year -Production cost very high	-Requirement for great technicality -Very high production cost. -Duration of high production

Sowing

- ✓ Technique is easy and not expensive.
- ✓ Fruit gives 150 seeds means 150 plants.
- ✓ Choose reddish seedlings and not showing necrosis
- ✓ Germination (with or without treatment) at the end of 20 to 25 days
- ✓

  Period: October-December, no problem of dormancy

  Direct sowing or in plastic pouch (cell)
- ✓ Problem of variability between plants

Propagation by cutting

- ✓ Technique is a little difficult
- ✓ Choose the woody cuttings from 20 to 30 cm

  Period: October-November

  Stratification in wet sand during winters

  Rooting at the end of 4 to 5 months

  Transplantation in Marsh-April

  No variability between plants

Transplantation of Seedlings

Period: February-April

Density: 1600 to 2500 (3600) seedlings/ha

Spacing: 2x2, 3x3 or 4x4 (variable density)

Holes: 30 to 50 cm x 15 to 20 cm

Exposure: south (Preferable)

- ✓ Soil preparation
  - To ploughing in surface manner (15 to 20 cm) , 4 to 5 times/year as of the second year of plantation
  - To weed at the youth, in a manual way or chemical
- ✓ Fertilization
  - Preferable to amend with manure;
  - Chemical fertilization is practised very little in morocco;
- ✓ Water requirement
  - The irrigation is practised only during the first year ;
  - 40 to 50 liters/ seedling / week increases the production of capers;

Harvest

The exploitation of the caper plant can be for its caper or its fruits. The capers mature during the period Marsh-June and even until September. The output by seedling depends on the climate conditions, variety, the area and the age of the seedlings. A branch of caper plant of Tafilalet contains 8 to 15 capers. A caper weighs surroundings 0.20 to 0.30 gr. The capers of Tafilalet have a varying diameter of 0.4 with 0.9 mm, of this fact they are in the category of capers sought by industry. A caper plant of Tafilalet counts 2000 to

4000 caper grains.

The output of the first year of production is about 0.6 kg/plant, in second year it is 1.3 kg/plant and more than 3 kg as from the fourth year. The caper plant can be exploited during a longevity from 30 to 40 years.

Other maintenance

- ✓ Pruning

  It is very important operation for the production of point of considering quantity and quality. The quantity of capers produced by plant depends on the number of formed branches. It is advised to cut at the beginning of each winter to support the departure of new branches. The branches must be cut with approximately a length of 0.5 to 1 cm.

- ✓ Phytosanitary protection

  The caper plant is sensitive to a certain devastating number:

  - The curculionidae attack the leaves and their larvae perforate the branches;
  - The larvae of certain butterflies corrode the top of the young branches and the buds;
  - The fly of caper plant damages the buds

  These vermin harm to the production quantitatively and qualitatively.

(5) Advantage of Caper Crop

Caper plant requirement

The caper plant is very little require, it can occupy of the uncultivated grounds and with low fertility. It can also resist to the extreme temperatures (17° C to 40° C). Its requirements out of water are weak and of work showed that at the time of its year of culture it is desirable, to increase the productivity, to bring 40 L maximum of water per week. On the level of Errachidia area, the caper plant weak pluviometry (less than 50 mm) and during years of dryness.

Ecological value of caper plant

The caper is cultivated in zones with variable topography, on rough grounds, rocks (Figure). It even can improve the fertility, the structure and the texture of the ground, which contributes to the paedogenisis. Indeed, the caper plant can restore an important biomass on the ground: one adult plant restores 211 gr/years organic matters.

The caper plant, with its deep roots and with high retention of the ground, can contribute to the fixing of

the ground and the fight against erosion. The caper plant is an ideal plant for programs of ground rehabilitation and the fight against the desertification.

Modes and possibilities of caper valorisation

The caper plant is natural resource whose exploitation can contribute to the generation of certain number of working day. This is possible in four manners :

- Production and sale of seedlings of caper;
- Culture of caper plant and sale of capers;
- Marinate-salty and sale the fruits and capers. The technique is very simple; it is enough to soak capers right after collection in a salt solution with 15% to 20% in weight. It is a technique also of conservation while waiting for the sale.
- To collect, to broil and to put the fruits of the caper in satchel. Moroccan companies currently export this type of product.

These various techniques from the caper plant are easy to practise on the level of Errachidia area.

Economical value of caper plant

The added value of the caper plant can be estimated in different manner. If we consider that a farmer has one hectare of planted ground of caper plant. The output of this surface and the average income can be as following: The average yield of a young seedling is 1 to 2 kg during the first two years of culture, at the fourth year; the yield can reach 4 kg/plant.

For a maximum density of 3600 plants/ha (culture of 2m x 2 m), the yield/ha is 3600 to 7200 kg of capers at the second year and 28800 kg at the fourth year of production. If we consider the current price 13 dh/kg (the price decreased from 30 to 13 Dh), the rough average incomes of the successive productions of the second and fourth years are from 54000 to 108000 Dh and 216000 Dh. We announce that harvest constitutes more than 50% of the production cost.

One worker can collect 8 to 10 kg/day of capers, this generates, for one ha and only one worker, 360 to 450 working days for the first two years productions and 3600 to 2880 working days for the fourth year of production.

This example of direct calculation informs about the great economic importance and the added value of the caper plant. The caper plant is a natural resource with high added value for an area to population stripped and alive under severe socio-economic and natural conditions.

4. Agro-Processing

In the Khettara Area, most of agricultural products are used as home consumption. Only a part of the products are soled in the local markets without any added value through agro-processing activity. In order to increase market value of agriculture products, demonstrations of agro-processing for date palm, henna and gumbo were proposed in the verification study. Based on the demonstration and post-demonstration results, the following manual was prepared.

4.1 Date Palm

(1) Summary of Specification

The remark for specification of date palm processing machine is summarized below:

Remarks for Specification of Agro-Processing Machine and Attachments

Agro-Processing Machine	Remarks	Necessity Attachment
Datte processing machine	Supplier advised that smaller date processing machine is recommendable. However, experimental station of ORMV pointed out that small processing machines are frequently blocked by processed date and, accordingly, are low productivity. As a result, the basic spec machine is selected.	Mold for datte pasting is required to lap the processed datte paste.

(2) Specification of Agro-Processing Machine

Item	Specifications	Unit	Quan
For Date Processing			
Datte processing machine	Cylinder L 30 cm, diameter ; chamber for cylinders and motor : L60 cm, l 45 cm support 60 cm Input table (cm) L 75, l :40 thickness 10 cm ; reception pan (cm) L25, depth 10 cm	U	1
Mold for datte pasting (1 kg)	18 cm x 10cm x 8cm dia 3 mm	U	1
Datte grinding mill/ Pasting machine	650 kg/ hour weight of machine 52 kg hole diameter of grid : 3,2 mm	U	1
Dietary plastic for dattes	l 30 cm, 130 microns	Roll	1
Datte press	L= 18 cm, l=10 cm ; H=08 cm, thickness : 1,3 cm, all steel made	U	1
Table	2x2 (m) made of Formica	U	1
Plastic box	Vegetable type	U	4
Chair	Normal wood	U	4

(3) Benefit and Observation

Based on the production records and purchase record for the processing machines, production cost and return are estimated and the result is as follows:

Production Cost and Return of Processing Machine

Item	Unit		Beni Ouzième	Ait Moulay Lmamoune
			Date Palm Paste	Date Palm Paste
Depreciation	(DH)	(1)	6,300	6,300
Materials	(kg)	(2)	2,200	1,400
Material Cost	(DH)	(3)	17,600	11,200
Production Cost	(DH)	(4)=(1)+(3)	23,900	17,500
Production	(kg)	(5)	1,760	1,110
Gross Income	(DH)	(6)	26,400	16,650
Net Income	(DH)	(7)=(6)-(4)	2,500	-850
B/C	-	(8)=(6)/(4)	1.10	0.95

Note: The price of date paste is estimated based on the actual market price of Beni Ouzièm (15 FH/kg)

The following fact-findings are noted for your reference.

- ✓ Participants for processing machines of dates could not fully use the machines, since

the machine was distributed during harvest season of date. However, it was confirmed that participants are very keen to use the processing machine. Therefore, operation hour and production volume will be improved in the next season.

- ✓ The balance between cost and return will be improved in the date paste processing, if the unit production volume increases.
- ✓ In the processing machines for date palm, the demand on home consumption was very large and, accordingly, the production could not sometime be used for sales.

4.2 Henna

(1) Summary of Specification

The remark for specification of date palm processing machine is summarized below:

Remarks for Specification of Agro-Processing Machine and Attachments

Agro-Processing Machine	Remarks	Necessity Attachment
Henna mill	It was confirmed that the basic specification is not required any modifications.	Packing machine will be applied, if enough budget is available.

(2) Specification of Agro-Processing Machine

Item	Specifications	Unit	Quan
For Henna Processing			
Henna mill	Production : 30 à 60 kg/1hour; 3 grids	U	1

(3) Benefit and Observation

Based on the production records and purchase record for the processing machines, production cost and return are estimated and the result is as follows:

Production Cost and Return of Processing Machine

Item	Unit		Taoumart Henna Mill
Depreciation	(DH)	(1)	430
Materials	(kg)	(2)	170
Material Cost	(DH)	(3)	1,300
Production Cost	(DH)	(4)=(1)+(3)	1,730
Production	(kg)	(5)	119
Gross Income	(DH)	(6)	3,570
Net Income	(DH)	(7)=(6)-(4)	1,840
B/C	-	(8)=(6)/(4)	2.06

Note: The price of processed henna is estimated on the actual local market price (30 FH/kg).

The following fact-findings are noted for your reference.

- ✓ In the processing machines for henna, the demand on home consumption was very large and, accordingly, the production could not sometime be used for sales.
- ✓ The financial feasibility of henna mill processing is good, since the initial cots for henna mill is small and the market price of processed henna is high.

4.3 Gumbo

(1) Summary of Specification

The remark for specification of date palm processing machine is summarized below:

Remarks for Specification of Agro-Processing Machine and Attachments

Agro-Processing Machine	Remarks	Necessity Attachment
Gumbo processing machine	It was confirmed that the basic specification is not required any modifications.	Drying rack will be required to dry processed gumbo.

(2) Specification of Agro-Processing Machine

Item	Specifications	Unit	Quan
For Gombo Processing			
Vegetable cutting machine	Motor 0,7 Hp et 515 W ; disc tours 300 / min, weight 24 kg, cutter for vegetable cutting in slices	U	1
Bagger and Welding machine	320x440x293 mm, welding rudder: 1x270 mm capacity : 8 m^3/ H	U	1
Plastic pouches for vegetable packing	L=280 ; l=150 ; thickness 80 microns	U	5000
Drying rack	Made of wood ; (L: 1 x l: 0,5 m) diameter of mesh holes (0,05 x 0,05)	U	4

(3) Benefit and Observation

Based on the production records and purchase record for the processing machines, production cost and return are estimated and the result is as follows:

Production Cost and Return of Processing Machine

Item	Unit		Sifa Gumbo Processing
Depreciation	(DH)	(1)	2,500
Materials	(kg)	(2)	450
Material Cost	(DH)	(3)	2,300
Production Cost	(DH)	(4)=(1)+(3)	4,800
Production	(kg)	(5)	300
Gross Income	(DH)	(6)	4,500
Net Income	(DH)	(7)=(6)-(4)	-300
B/C	-	(8)=(6)/(4)	0.94

Note: The price of processed gumbo is estimated on the price which will be applied by beneficiaries (15 FH/kg).

The following fact-findings are noted for your reference.

- ✓ The balance between cost and return will be improved in the date paste and gumbo processing, if the unit production volume increases.

5. Livestock

In the Khettara Area, although agriculture has been main income source, the less rainfall in past ten years causes decrease of agriculture production. It is, therefore, understood that the additional income sources other than crop cultivation have to be found, since income source is very limited in the Khettara Area. In the verification study, rabbits and pigeon breeding as potential income source was examined in terms of technical and financial aspects. Based on the **guideline of ORMVA-TF** and demonstration results, the following manual was prepared.

5.1 Rabbit

(1) Rabbit houses

When we construct a rabbit house; it should have the following conditions:

- Easy conditions for work
- Comfortable condition for animals

Notes for the implementation and construction of rabbit houses:

- Avoiding noise
- Hygiene
- Number and size of breeding rooms
- Width of the exit of house

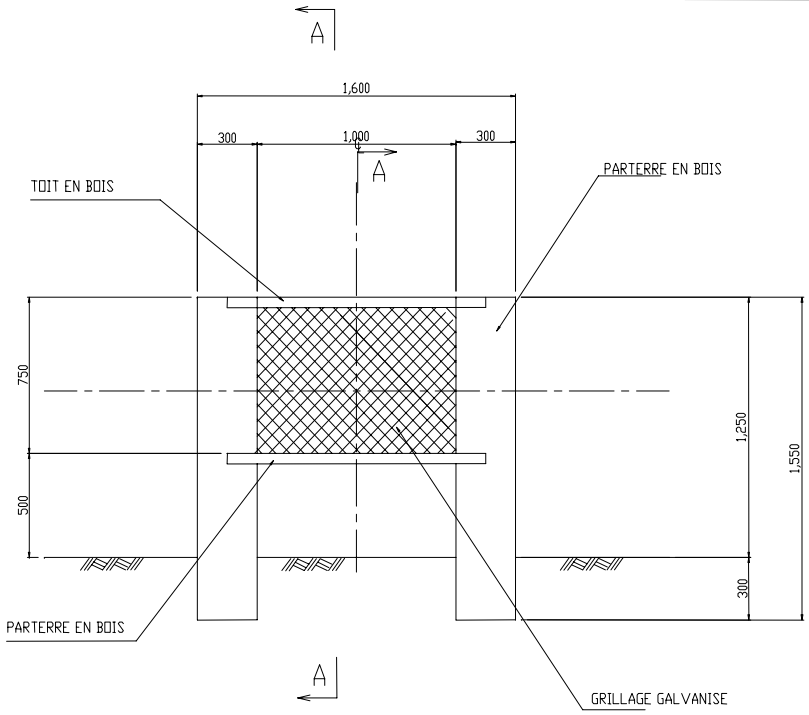
Notes for rearing conditions:

Temperature: it is the most important factor:

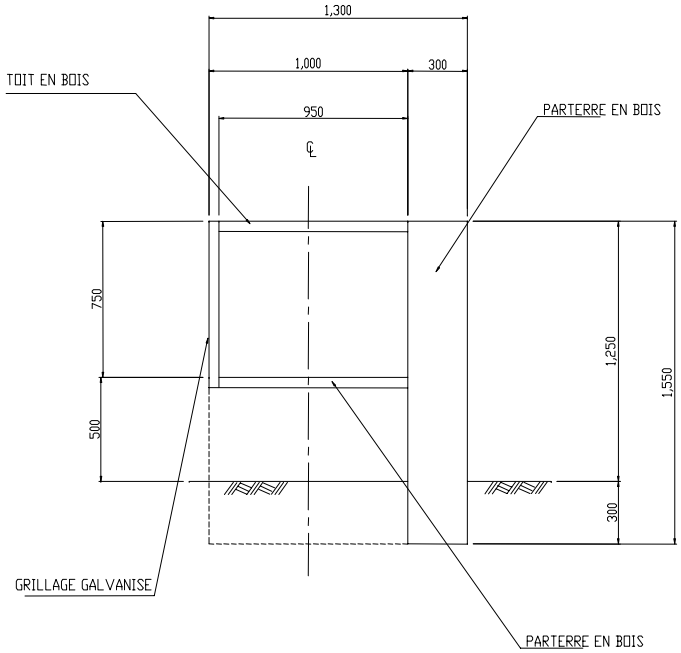
- Sanitary condition for young rabbits
- Cool is the reason of death and source for respiratory and digestive diseases
- Heat is the source of indigestion and death

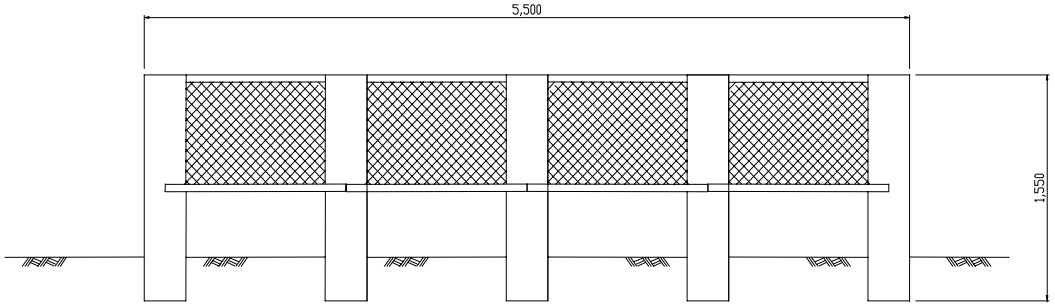
Standard design applied in the verification is shown in the next page:

PLAN DES CLAPIERS

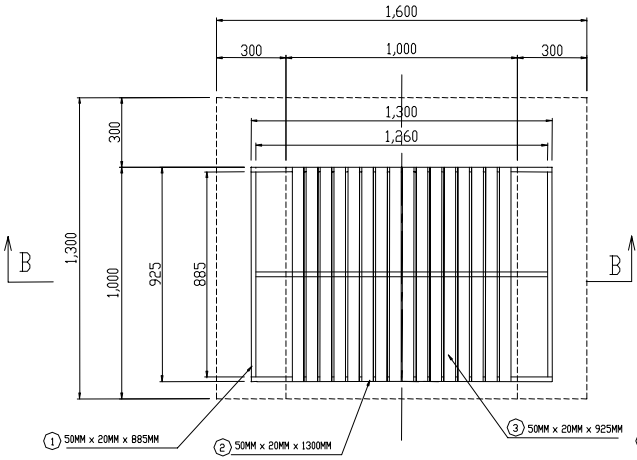


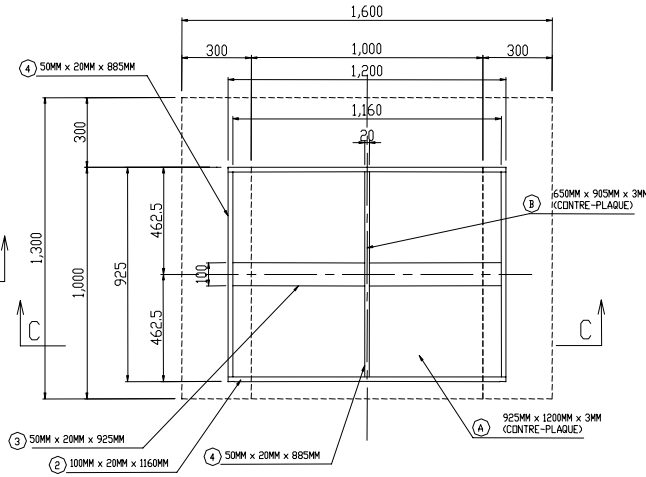
SECTION A - A

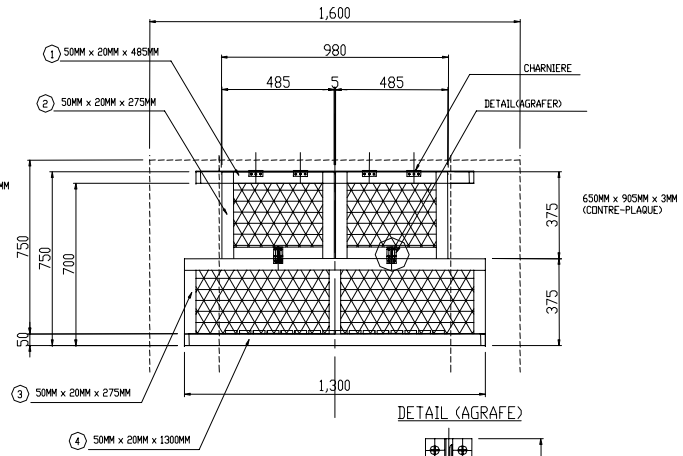




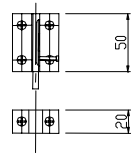
PLAN DES CLAPIERS







DETAIL (AGRAFE)



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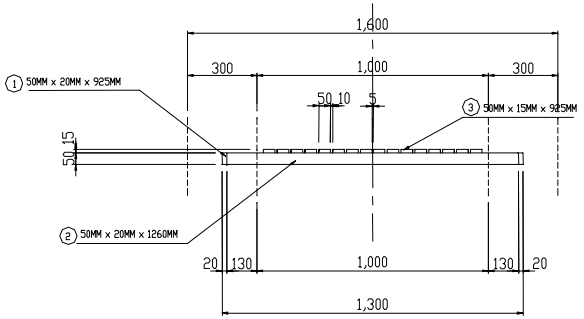

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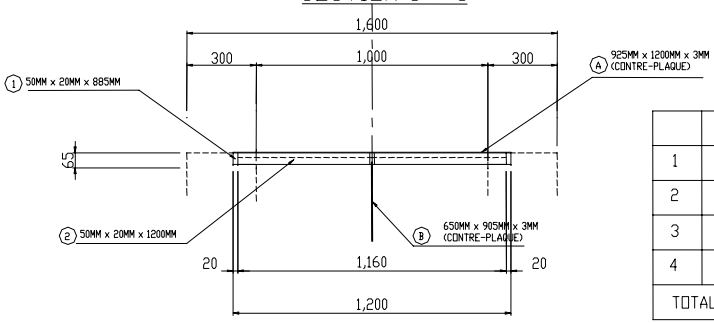


MATERIERE DE CHASSIS POUR GRILLAGE GALVANISE

	B(M)	W(M)	L(M)	V(M3)	N	TV(M3)
1	0.050	0.020	0.485	0.0005	4	0.0020
2	0.050	0.020	0.275	0.0003	4	0.0012
3	0.050	0.020	0.275	0.0003	3	0.0009
4	0.050	0.020	1.300	0.0013	2	0.0026
TOTAL						0.0067

MATERIERE DE PARTERRE EN BOIS

	B(M)	W(M)	L(M)	V(M3)	N	TV(M3)
1	0.050	0.020	0.885	0.0009	2	0.0018
2	0.050	0.020	1.300	0.0013	4	0.0052
3	0.050	0.020	0.925	0.0009	16	0.0144
4						
5						
6						
TOTAL						0.0214

MATERIERE DE TOIT EN BOIS

	B(M)	W(M)	L(M)	V(M3)	N	TV(M3)
1	0.050	0.020	0.885	0.0009	2	0.0018
2	0.050	0.020	1.200	0.0012	2	0.0024
3	0.100	0.020	1.160	0.0023	1	0.0023
4	0.050	0.020	0.885	0.0009	1	0.0009
TOTAL						0.0074

MATERIERE DE CONTRE-PLAQUE

	B(M)	W(M)	T(M)	A(M2)	N	A(M2)
A	0.925	1.200	0.003	1.110	1	1.110
B	0.650	0.905	0.003	0.588	1	0.588
TOTAL						1.698

(2) Introduction of rabbit

Purchase of reproductive rabbits:

- Females should be borne from healthy and prolific parents.
- For males, the same sanitary qualities as females in addition to a high sexual enthusiasm.

Delivery:

- Delivered animals should be of different ages between 8 to 14 weeks
- At their arrival, females are kept together, according to their age in order to minimize the stress, males are individually kept in their cages.
- Houses and materials should be cleaned and disinfected at least 15 days before the arrival of reproductive rabbits.

Reproductive rabbit installation:

- Reproductive rabbits should be identified, for this reason each animal will have a monitoring sheet including its identity card and work book.

(3) Reproduction

Sexual behavior

- For male rabbits: We can judge it according to:
    - The interest towards the female
    - The aggressiveness towards the female
    - The necessary time for covering after introducing the female into the male's cage

Age of reproduction

- Male : 19 to 20 weeks
- Female : 15 to 16 weeks

Results of coupling within the year:

- Spring : Female rabbits accept male ones.
- Autumn : No desire from female rabbits.
- Winter : Unfavourable for female rabbits (heater is required)
- Summer: Unfavourable for male rabbits (weak fertility) cooler is required.

Selection of the coupling time:

- It is preferable to realize the coverings early in the morning or in the evening mostly in summer time

Sign of sexual desire of the female rabbit:

- Let be easily astride
- Held up the back tram
- After coupling the male rabbit falls down behind or beside with a characteristic scream

Sign of no sexual desire of the female rabbit:

- Isolation in a cage corner
- Grunts and sometimes becomes aggressive

Different ways of coupling:

- **Normal coupling:** The female rabbit is introduced to the male rabbit cage twice a day, morning and evening.
- **Directed coupling:** we use it when a female rabbit refuses the male; we put the hand under its stomach in order to elevate the back tram, the other one turning down the tail on the back.
- **Before giving birth:**

  The gestation period for female rabbits is from 31 to 32 days with some extremes of 29 to 34 days. The female rabbit, having a long gestation gives after 33 days, it is necessary to palpate female rabbits around the 28-29th day of gestation in order to install the nest box which should be furnished with absorbent materials (straw, hay and cotton)

The giving birth and associated operations:

- The giving birth very often takes place in night time, the female give birth of a variable of new nude and blind baby rabbits (1 to 16) with an average of 7.5.
- **Birth weight:**

  The weight of one day baby rabbit is from 450 to 550 grams
- **Accident during the giving birth:**

  Wrong opening of the box

  Wrong box fixation, due to the giving birth on mesh
- **Control of the nest after giving birth:**
  - Should be noiseless
  - If the nest box is equipped with a closure device or in order to make it play mostly if the female rabbit seems to be aggressive.
  - In general, we have not to leave more than 11 baby rabbits for one female, adaptation must be applied.

The covering:

- We have to consider the number of newly born baby rabbits, if they are less than 6 alive rabbits we advise a covering 10 days after the giving birth, always introduce the female rabbit into the male rabbit's cage.

Gestation control:

- It is realized through abdominal palpation 10 days after the covering in order to optimize the occupation of cages by mothers. If the control is negative, the female rabbit will be immediately presented to the male.

The weaning

- Weaning is realized in 24 to 26 days.

- Wean all the born rabbits at once, these baby rabbits are put either in fattening cages or in breeding cages (in order to replace the invalided out male or female rabbits)

- During the weaning, it is advisable to regroup animals which are to be fattened according to their age.

Recall the rabbit physiology:

- Cycle : Varies from 4 to 7 days.
- Ovulation : Caused by coupling
- Gestation : 31 days duration

Zoo technical performances:

- **Maternity criteria:**

- Number of new birth, 1 time/ rabbit/year : 6.5
- Number of alive baby rabbits at one birth time : 7.8
- Number of weaned baby rabbits at one birth time : 6.7
- Number of weaned baby rabbits/ one female / year : 39.45

- **Fattening criteria:**

- Felling age : 82-89 days
- Average weight during felling : 2.3 – 2.4 kgs
- Output of filling : 57%

Problems in rabbit breeding:

- Refusal of covering**:**
- The strong heat
- Diminution of luminous intensity
- Condition of animal good point
- Interval between the covering and giving birth

Non fertile covering:

- The same as the previous, to which we add
- The harmful influence of systematic treatments.
- Sulfamide (coccidiose)
- Enterotoxaemia

Abortion:

- Lack of tranquillity (dogs, cats, rats, birds)
- Consanguinity
- Infectious factors
- Low temperature
- Insufficient drinking water

Abundance of litter and cannibalism

- Insufficient drinking water
- Lack of tranquillity
- Infectious factors

(4) Feeding

Quantity of concentrated food to be delivered

Physiological stages	Qt/ in grs	Remarks
Reproductive males	140-150	According to its utilization
Future reproductive	140	Starting from 9-10 weeks, very strict food intake
Female rabbits at maintenance		
Less than 28 days Pregnant rabbits		Except when we apply post partum covering
More than 28 days Pregnant rabbits	unlimited	We can reduce food intake two days and one day before giving birth
Suckling female rabbits		Not to forget to rationalize after weaning in case of less than 28 days gestation
Pregnant and suckling rabbits		
Baby rabbits between 3-7 days after weaning	50	
Baby rabbits in fattening	Unlimited	Don't feed one day before felling if this operation is done for breeding, possibility of one day fast every week

5.2 Pigeon

(1) General

The pigeon breeding has good perspectives for the future. This sector is called to develop and widen its production in order to rapidly cover the market need of animal products with a low price.

The consumption of white meat is:

- Developed countries : 20 kg/ habitat/ year
- Morocco : less than 6 kg white meat/ habitation/ year

(2) General Hygiene

- The general hygiene for pigeon breeding targets the maintenance of balances between the exploitation, infectious agents and environment.
- The breaking of general hygiene rules causes the immediate apparition of sanitary problems which threaten the zoo sanitary performances; therefore a rigorous hygiene is required.

(3) Pigeon house

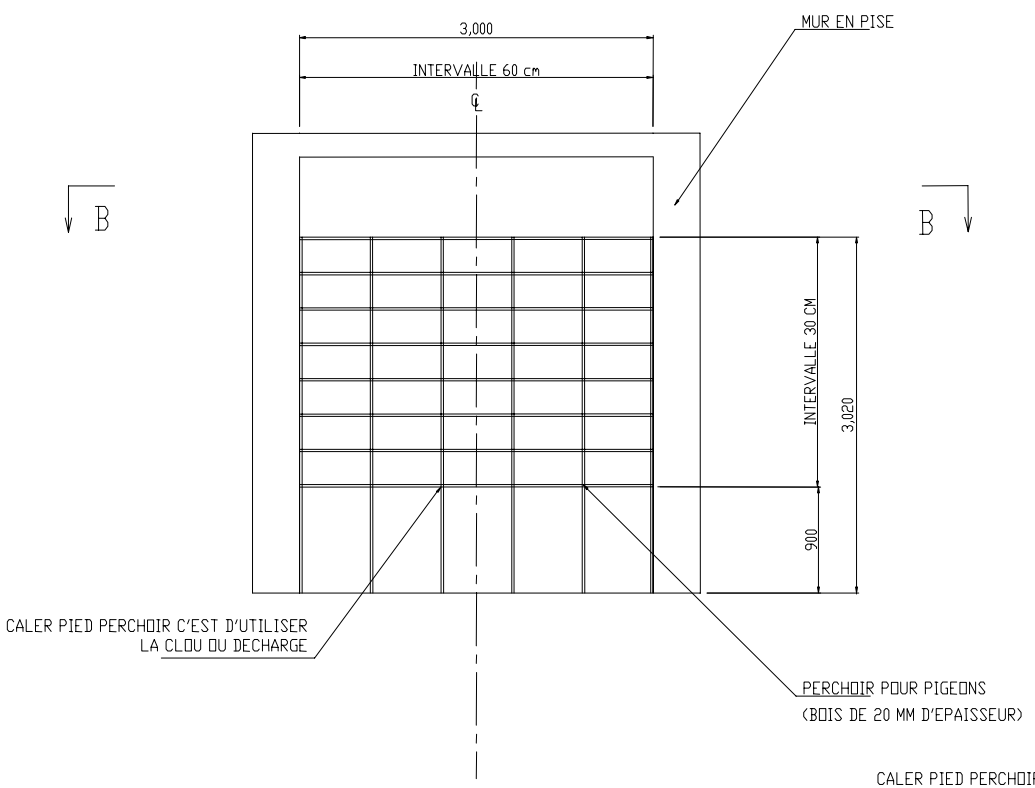
- Orientation: avoid dominant wind

Exp: Infectious bronchitis virus or of new castell can be transmitted by the wind to 5 km.

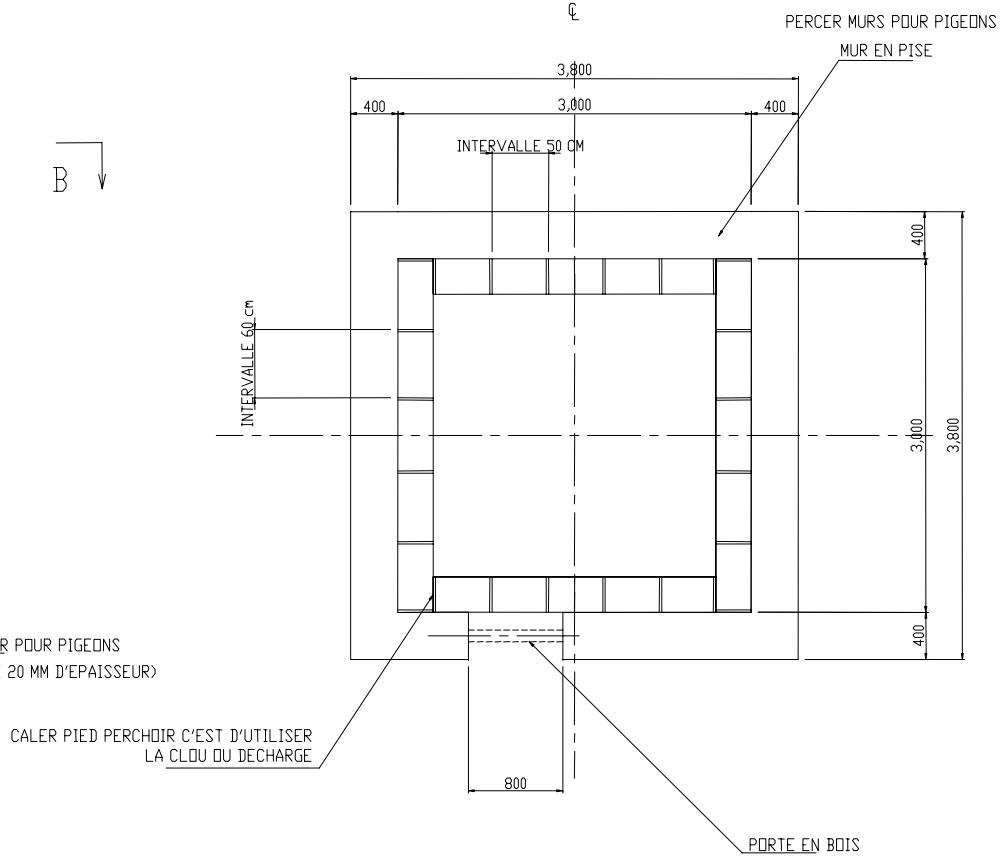
- Respect the distance between breeding: plus 1 km
- Acquisition of an adequate plan according to breeding type
- Cleaning of pigeon house: the wastes must be evacuated outside the pigeon house and taken as far as possible.
- Respect of sanitary emptiness
- Disinfection of pigeon house after each band
- Struggle against undesirable insects and animals.

Standard design is attached in the next page.

PLAN DES PIGEONNIRES



SECTION B - B



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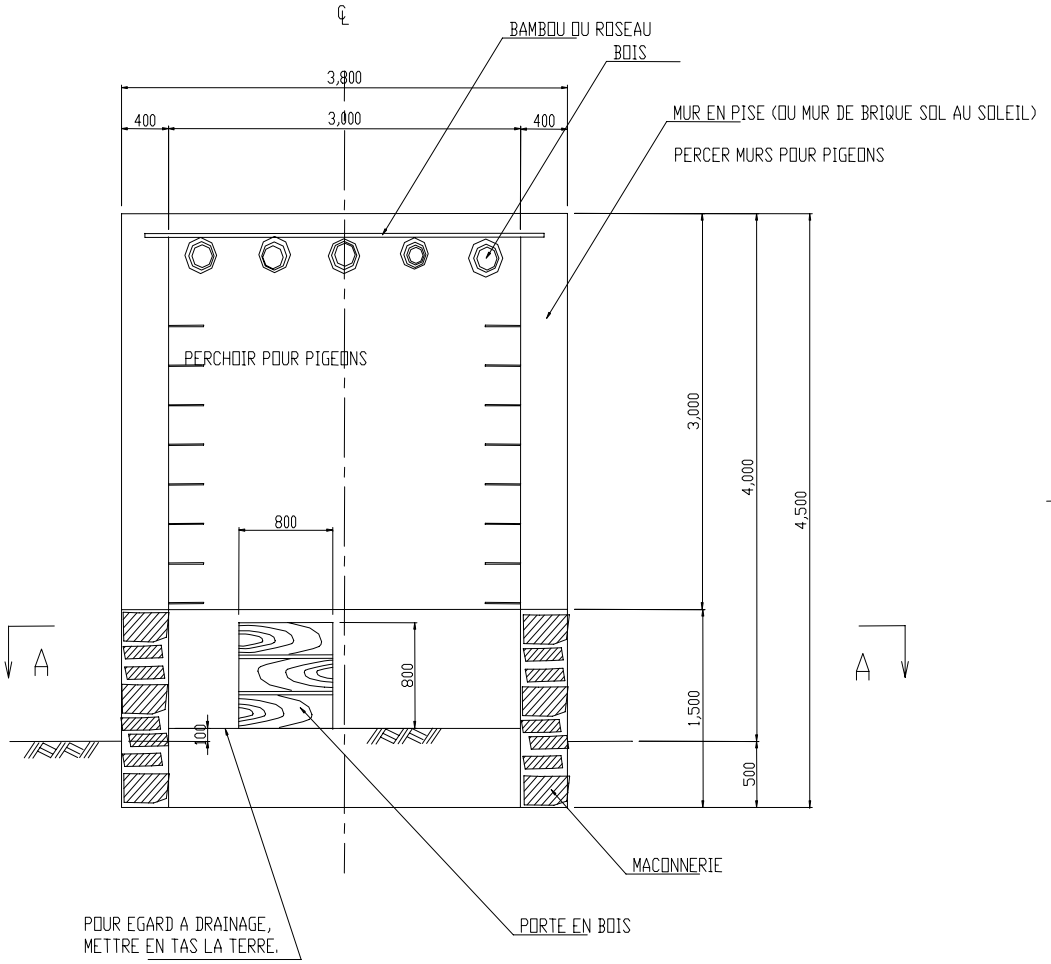
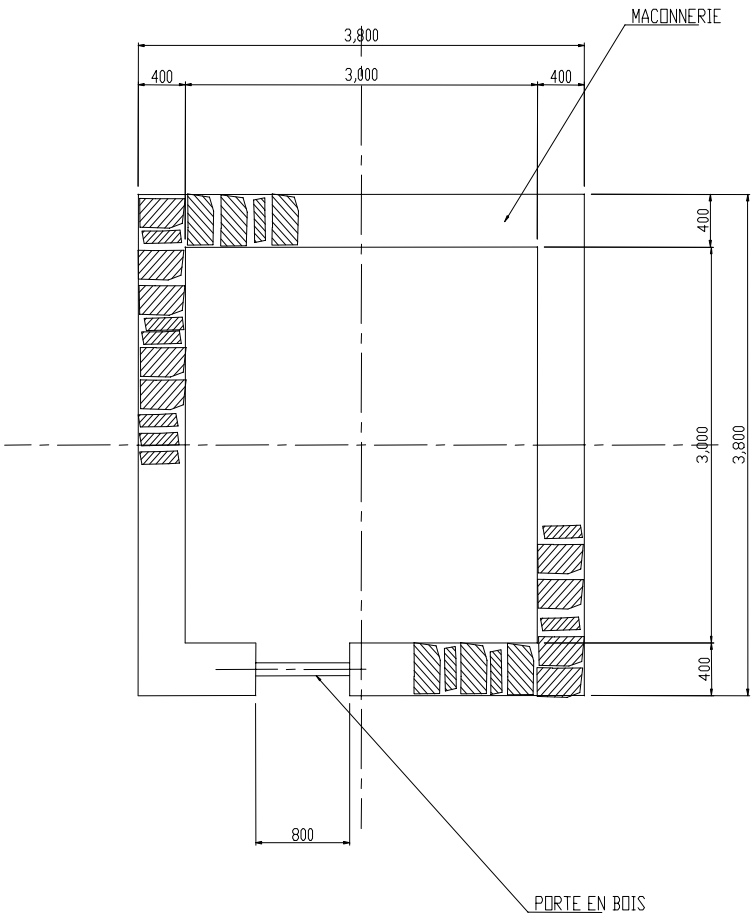
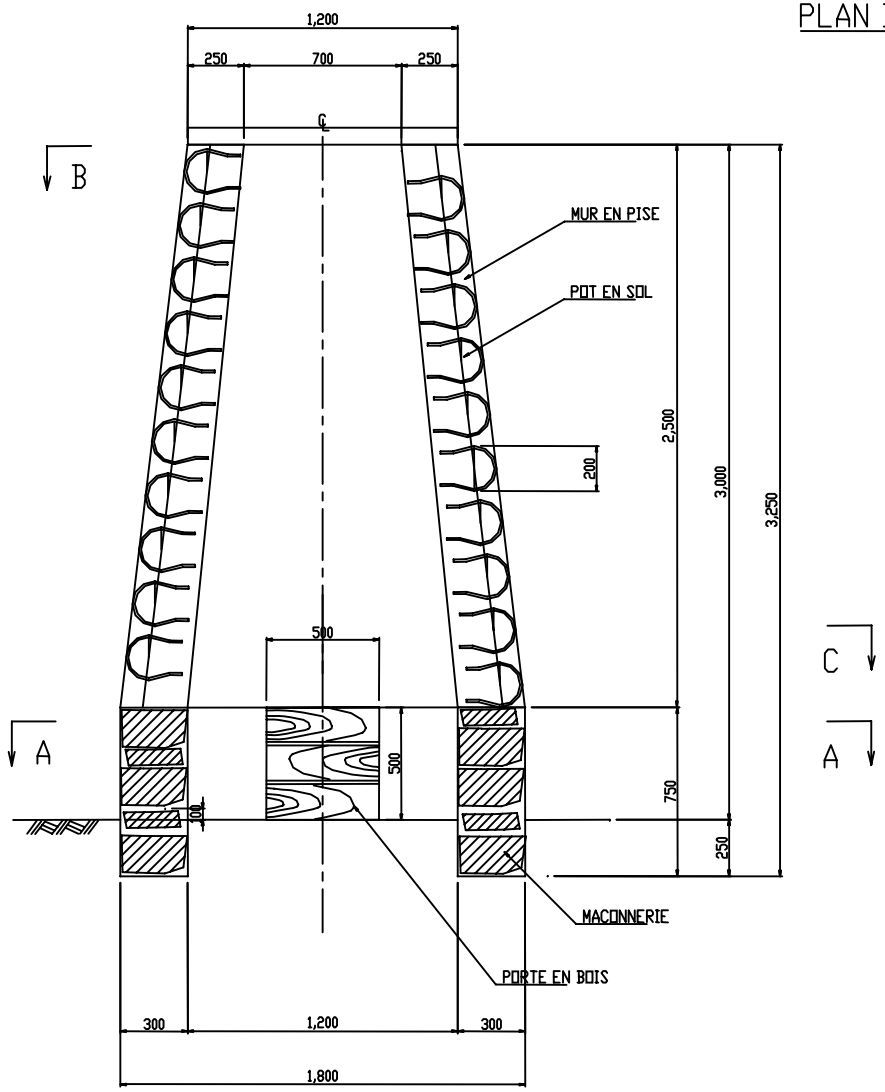


SECTION A - A



PLAN DES PIGEONNIRES



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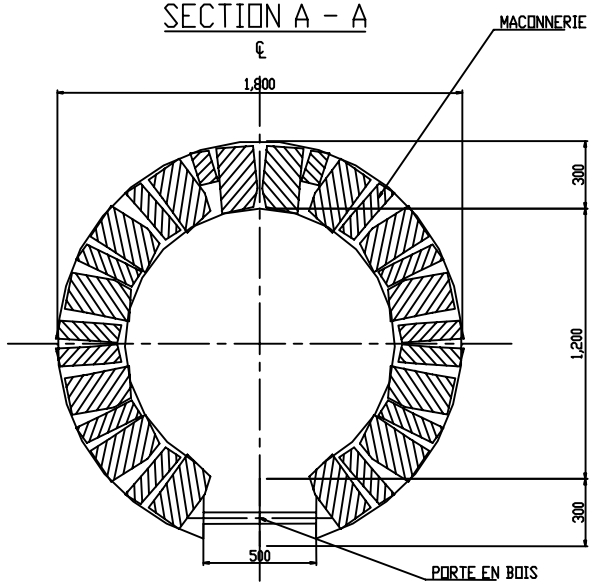

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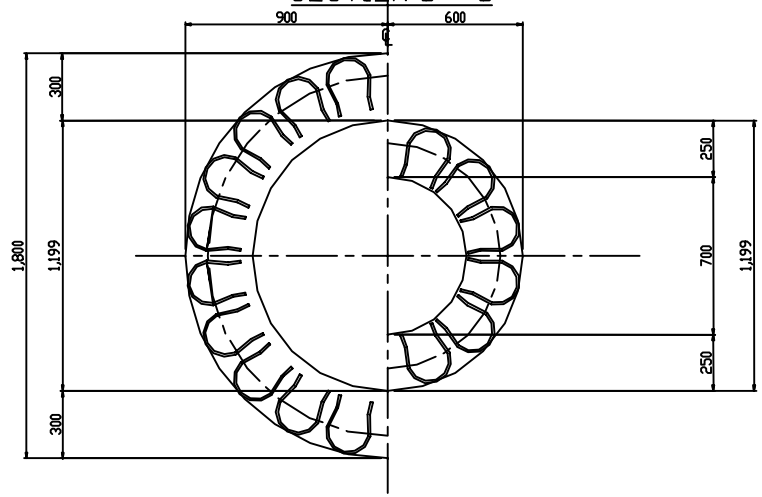

(4) Hygiene of staff

- Avoid the passage from one breeding to another
- Utilize the pedicures containing bleach or soap water.
- Adequate clothing of the staff
- Medical visits and sanitary card of the staff
- Avoid retailers entrance into the henhouse

(5) Breeding equipment

- Utilization of mangers and spheroid or linear drinking troughs which are specific for pigeon breeding.
- The breeding material constitutes a contamination source.
- We should avoid circulation or borrow of these materials.
- Disinfection through immersion in disinfectant solutions after every use (even with gas butanes)
- Daily cleaning and checking of the manger and the drinking troughs in order to avoid water loss and humidity of the litter.
- Mangers are also adjusted and cleared up from excrements and moisture.
- Avoid that the straw which is used as litter be dusty, thorny or mouldy.

(6) Prophylaxis

Medical:

- In order to allow animals a good protection against viral diseases it is indispensable to follow an adequate vaccination schedule established according to the breeding types, sanitary conjunctures in the area and dominant pathologies.
- Rational utilization of veterinary products according to veterinarian advice.

Sanitary:

- Daily monitoring for the sanitary evaluation
- Daily evacuation of dead pigeons
- Isolate sick animals
- Avoid abrupt introduction of new subjects.
- Destruction and burial of dead pigeons

(7) Food

The pigeon is essentially grain eater, but also likes fresh vegetables. In addition to its need for mineral salts. We can content with feeding exclusively with wheat, which is very cheap, but in order to satisfy all athlete needs (traveller pigeons) it is preferable to serve them a mixture of equilibrated grains.

The specialist traders will propose all kinds of mixture (breeding, widowhood, moulting….) these mixtures contain wheat, maize, barley, pea, bean, etc...

Opinions are shared regarding the utilization of such or such mixture and everyone finds one's mixture the best. We provide three meals in summer and two in winter.

The male and female give food to the baby pigeons as soon as they come out of the egg. Baby pigeons are feed with crop milk. In six days small pigeons eat baby's cereal and grind grains. In four weeks the bay pigeons would like to fly from their nest.

(8) Reproduction

Baby pigeons either in nature or being breed always live in two. Ten days after coupling the female lays one egg, two days later another egg.

It is advisable to separate pigeons during 15 days, in order to be able to couple them as we want. We introduce the female into the male's box.

Basically, the pigeon is monogram, but it easily change partner.

The young travelling pigeons can be coupled after 3 to 4 months. It is necessary to provide them with straw and twig so as to allow the couple to make their nest.

The laying occurs ten days after coupling. The female laid two eggs, the first one late in the afternoon, and the other early afternoon two days later.

The brooding takes place during 17 days after the lay of the second egg. The parents alternately brood: the female on the morning and in the evening, the male in the afternoon.

(9) Baby

At the birth, the baby is blind and just covered with a down. It is advisable not to touch them during the first week after birth in order to avoid any loss.

The parents throw in the babies' beaks pedigreed food inside crop of young which is extremely rich milk containing vitamins, fats, and proteins.

During the first ten days (location period), baby pigeons are developed in a very fast speed due to the richness in milk. From 10 days, the baby pigeon start to get feathers until 28 days.

Baby pigeon leave the nest 1 month after their birth.

(10) Pigeon Disease

Most of the diseases are due to overpopulation, to lack of hygiene and to mistakes which are made during feeding: lack of mineral matters and vitamins, lack or excess of proteins.

In a very well air conditioned, cleaned and regularly disinfected pigeon house where the grain is always dry and clean, and the drinking trough, pigeons are scarcely sick.

The sick animal doesn't eat, it is inert; feathers are ruffled and the wings are hanged.

Immediately isolate these sick animals. In most of the cases, we have to consult a veterinary or to sacrifice the sick animal, if no treatment is effective.

List of Disease to Pigeons

Disease	Symptoms
Coryza	Nose flowing Burning sinus
Variole	Pustules
Diphtheria	Fast and whistling breathing Whitish membrane in the beak and the pharunx, oesophagus… difficulty to swallow
Trichmonose Salmonellose)	Diarrhea, abscess in the beak, the pharynx, esophagus…difficulties to swallow
Coccidiose	White / green/ bloody diarrhea
Parathyphose (salmonellas)	Liquid diarrhea (water) pigeon drinks a lot, wing pain
Colibacillose	Liquid diarrhea, loss of weight
Adenovirose	Liquid diarrhea, loss of weight, cough, and pigeon drinks a lot…
Gale	loss of localized feathers,
Newcastle	Paralyzed neck, retraction of the head…

(11) Vaccines against Newcastle disease

The recommended outline is:

- Vaccination at the beginning of the year, before vaccination campaign: all pigeons of more than 5 weeks including adults vaccinated ones during the previous year, are vaccinated with an inactive vaccination which is inactivated with a emulsion …
- Vaccination during the campaign season: all pigeons which were born during the campaign season are vaccinated since the age of 5 weeks with an inactivated and oily emulsion vaccine.
- It is necessary that the quantity of vaccine which is injected must be correct. The injection must be practised