ICARDA

Australian Government
Australian Centre for International Agricultural Research

# Adapting Conservation Agriculture for Rapid Adoption by Smallholder Farmers in North Africa(CSE-2011-025)

Plan of Work and Budget

September 2012 - August 2013

ITGC

Institut National de la Recherche Agronomique

INGC

# Adapting Conservation Agriculture for Rapid Adoption by Smallholder Farmers in North Africa(CSE-2011-025)

Draft Plan of Work and Budget

September 2012 - August 2013

## 1. Objective 1. To identify constraints to adoption of CA by smallholder farmers and ways of enhancing adoption, most importantly identifying and testing socioeconomic options

*Operational coordinator: Dr. Boubaker Dhehibi (ICARDA)*

### 1.1. Activity 1.1. Characterize the 3 platforms and conduct similarity studies within country and across the region for efficient project implementation and result out-scaling

#### 1.1.1. Algeria

**Team in charge**

| Name | Time allocated |
|---|---|
| Oumedjkane Kahina | 20 % |
| Bouhaouchine Larbi | 10 % |
| Djennane Abdelmajid | 5 % |
| Rouabhi Amar | 5 % |
| Ghanem Youcef | 2 % |

**Justification**

- Descript of agro- ecological and socio-economic data of the platform, and similarity analysis in the country and in the region.
- Develop of baseline information of the platform for to implement research and development activities.

**Objective**

- Define the environmental challenge or environmental priorities depending on the cultural context and ecological conditions:
- Define the technical innovation system, production systems, experimentation, technology dissemination channels;
- Define the technical difficulties on inputs and equipment,
- Define the changes in agricultural practices, more traditional practices and new technologies, new industries, extensification through direct contact with farmers to study change in agricultural practices (inputs and equipment), change on the production system and the economy of the farm, and change in global environment and analyze the constraints to find possible solutions including industry for machines;

- Analyze the economic risks (production decrease and loss of income), and the risks of global change or environmental degradation;
- Define the mode of incitement; technical standards, extension, technical efficiency and economic subsidy;

## Methodology

Data will be collected as follows:

- Series of monographs study;
- Diagnostic of general environment;
- Conduct a comprehensive baseline survey of 100 farmers on:
  - The practiced agricultural and non-agricultural activities
  - The resource endowments both in terms of quantities and fragileness (topography, soil hydromorphy, grazing density, etc.).
  - The practical constraints of mechanization
- Conduct benefit/cost ratio analyses (statistical and index analysis);

## Milestones

- Full report of the activity to be submitted detailing :
  - Site characterization ;
  - Descriptive analysis of socio-economic baseline studies;
  - National workshop.

| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Mai | Jun |
|---|---|---|---|---|---|---|---|---|---|
| Choice of farmers | X | | | | | | | | |
| Questionnaire elaboration & circulation | | X | | | | | | | |
| Questionnaire testing & adjustment | | | X | | | | | | |
| Survey implementation | | | | X | X | | | | |
| Data cleaning & entry | | | | | | X | | | |
| Data analysis & reporting | | | | | | | X | X | |
| Annual report delivered & National workshop | | | | | | | | | X |

## Inputs

- Consumables (paper, flash disks, External disk drives)
- Office supplies

## Budget

- See table Budget

### 1.1.2. Morocco

#### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | M. Boughlala | 5 |
| | O. El-Gharras | 5 |
| | M. El Koudrim | 3 |
| | O. Benhalima | 1 |
| AGENDA | A. El Brahli | 2 |
| | A. Tanji | 2 |
| RSSA | | |
| ICARDA | B. Dhehibi | 5 |
| DPA | H. S. Zaghloul | 1 |
| CT Oued Zem | K. ELKILI | 1 |
| | K. SOKRAT | 1 |

#### Justification

Description of the agro-ecological and socioeconomic characteristics of the selected platform is essential step for measuring the project impact and providing the sustainabilityindicators.It will also assist in the development of the technical work-plans.

Results of the similarity study will be used to target farmer groups and identify domains for application and result out-scaling within the country.

One sub-activity related to socioeconomic component in the project is to carry out baseline surveys at the level of the selected platform. Baseline surveys usually use to collect information on selected indicators and/or variables at a certain point of time in a benchmark or pilot sites.

#### Objective

- Describe the basic socio-economic characteristics of the selected platform including population characteristics, employment and source of income, market access, agricultural production system, property rights, policy and institutional support.
- Describe the basic agro-ecological characteristics of the selected platform including climate characteristics, topography, soils, water resources, land use, land cover, and land degradation.
- Produce a database on selected indicators and variables that describe the initial situation at the platform level.

#### Expected output

Report detailing agro-ecological and socio-economic characterization and typology of the different production systems in the target platforms and similarity analysis.

#### Methodology

- A multi-stakeholder workshop will be organized at the platform level to explain the project objectives and to introduce CA technology with details on application opportunities and challenges and to raise interest and trigger questions, comments and suggestions by participants. Full sessions will be devoted to assessing stakeholders (especially farmers) attitudes, expectations and potential weaknesses and difficulties.
- Secondary data will be collected from available published and unpublished sources.

- Primary data collection will be utilized in the study to collect data on communities, agricultural production, marketing channels, farming practices and other socio-economic aspects. To collect this information we will use a rapid rural appraisal (RRA) survey.
- A baseline survey will be conducted using a sample of 100 farmers per platform including the 30 farmers involved in on-farm research.

### Milestones

| Milestones: | Completion dates | Persons in charge |
|---|---|---|
| Sampling | Oct. 2012 | Boughlala and project team |
| Questionnaire elaboration | Nov. 2012 | Boughlala and project team |
| Questionnaire testing & adjustment | Dec. 2012 | Boughlala |
| Survey implementation | Feb. 2013 | Boughlala and project team |
| Data cleaning & entry | Mar. 2013 | Boughlala |
| Data analysis & reporting | May 2013 | Boughlala and project team |

## 1.1.3. Tunisia

The Tunisian plan of work will take into consideration the objective of promoting adoption of CA by smallholder farmers in sub-humid zone to reduce natural resource degradation and to increase productivity, profitability and sustainability of the crop/livestock systems in the region. Activities will be held at the delegation of Fernana (Governorate of Jendouba) characterized by an average annual rainfall of 700 mm. Wheat yields in rainfed conditions in the Fernana area are quite low (13 quintals/Ha). This area is favorable to the development of cropping systems incorporating legumes. This delegation was not touched by previous development programs. The landscape is very sloped facilitates soil erosion, so the region s very well suited for conservation agriculture practices.

The document summarizes the activities that will be implemented in the fields during the crop year 2012-2013 as well as the training and mobility activities planned for the 3 objectives of the project.

### Team in charge

| Name | Time allocated |
|---|---|
| Boubaker Thabet (INAT) | 15% |
| Maâroufi Hayet (INGC) | 20% |
| Raja Nabli (INGC) | 10% |

### Justification

Description of the socioeconomic characteristics of the Fernana platform, including its biophysical data, production systems, land use, farming practices, rural settlements, and main features of rural livelihoods is an essential component of the research program. This activity establishes the baseline information and data that are needed to design experiments and develop ways of (i) evaluating these experiments and (ii) developing baseline information that can be used to evaluate research impacts. This activity will generate baseline information that can be used by the entire research program as reference for evaluating technology performance CA.

### Objective

The objective is to develop baseline information on the platform that will serve as a reference for evaluating the performance of the CA technology.

## Methods

- Formal survey will be conducted in the Fernana platform to characterize cropping systems covering 100 farmers off a list of estimated 4200 farmers in the platform
- The questionnaire will cover production systems, land use and features of rural livelihoods
- Economic and statistical analyses of survey data will be performed using typical computer programs (Excel, SPSS, etc.)

## Measurements

- Survey implementation will lead to primary data to be analyzed along with possible secondary data that will be collected from regional and local services.

## Milestones

- A report will be produced on the activity detailing :
  - Site characterization (agro-ecological and socio-economic characterization, typology of the existing production systems, )
  - Descriptive statistical parameter estimation of farm/household activities (marketing of produce, nutrition status, etc.).
- Participation in national workshop

## 1.2. Activity 1.2. Study farmers behavioural change and analyse constraints to adoption of CA systems in the three platforms (including mechanisation aspects and machinery supply industry)

### 1.2.1. Algeria

## Team in charge

| Name | Time allocated |
|---|---|
| Oumedjkane Kahina | 20 % |
| Bouhaouchine Larbi | 10 % |
| Djennane Abdelmajid | 5 % |
| Rouabhi Amar | 5 % |
| Ghanem Youcef | 2 % |

## Justification

- Analyze of the constraints to adoption of CA systems and development of acceptable alternatives to improve the adoption.
- Analyze the behavioural change of the farmers.
- Define the changes in agricultural practices, more traditional practices and new technologies, new industries,
- extensification through direct contact with farmers to study change in agricultural practices (inputs and equipment),
- change on the production system and the economy of the farm,

- Change in global environment and analyze the constraints to find possible solutions including industry for machines;
- Identify the existing equipment for CA and industry capacities.
- Develop of baseline information

## Objective

Direct contact with farmers to study change in agricultural practices (inputs and equipment), change on the production system and the economy of the farm, and change in global environment and analyze the constraints to find possible solutions including industry for machines.

## Materials and methods

- Review of the literature.
- Quick survey (RRA);
  - Development and validation of quick questionnaire;
  - Sampling in the intervention area (population targeted 100 farmers);
  - Elaboration, compilation and analysis data from questionnaires;
  - Report production.
- Survey of 100 farmers interviewed for behavior change
  - Development and validation of detailed questionnaire
  - Sampling in the intervention area (population targeted 100 farmers)
  - Elaboration, compilation and analysis data from questionnaires.
  - Report production.
- A national workshop for presentation and discussion of results
  - Identification of the technical difficulties and risks of global change, environmental and economic risks.

## Milestones

- Analyze the constraints to adoption of CA systems;
- Descriptive analysis of industrial capacities;
- Conclusive results disseminated through a national workshop.

| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Mai | Jun |
|---|---|---|---|---|---|---|---|---|---|
| Choice of farmers | X | | | | | | | | |
| Questionnaire elaboration & circulation | | X | | | | | | | |
| Questionnaire testing & adjustment | | | X | | | | | | |
| Survey implementation | | | | X | X | | | | |
| Data cleaning & entry | | | | | | X | | | |
| Data analysis & reporting | | | | | | | X | X | |
| Annual report delivered & National workshop | | | | | | | | | X |

## Inputs

- Consumables (paper, flash disks, External disk drives)
- Office supplies

## Budget

- See table Budget

### 1.2.2. Morocco

#### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | M. Boughlala | 10 |
| | O. El-Gharras | 5 |
| | M. El Koudrim | 3 |
| | O. BENHALIMA | 1 |
| AGENDA | A. El Brahli | 2 |
| RSSA | | |
| ICARDA | B. Dhehibi | 5 |
| DPA | H. S. Zaghloul | 1 |
| CT Oued Zem | K. ELKILI | 1 |
| | K. SOKRAT | 1 |

#### Justification

Soil degradation is an important threat to food production and security in Morocco. Research results in Morocco show that with adoption of no-tillage (conservation agriculture principles), farmers, independently of their tenure and acreage, can re-build the harmony between soils and crops, and escape adverse effects of climate. According to soil scientists, no-tillage technology save soil moisture, fuel, labor, and machinery costs, as well as reduce wind and water erosion. Despite the perceived benefits of this technology, adoption rates worldwide have been low, particularly among small farmers in developing countries. This is true in Morocco, even though field trials conducted by INRA Morocco have been largely successful from an agronomic point of view. In this activity barriers of adoption will be explored and perspectives of this technology will be given.

#### Objective

The main objective of this activity is to study farmer's behavioral change and identify the main constraints to the adoption of CA systems in order to develop sound and acceptable CA packages to increase likelihood of adoption.

#### Expected output

Analysis and documentation of current technical, institutional and organizational constraints hindering the adoption of CA systems.

#### Methodology

The methodology will be mainly based on the review of existing documentation at country level. A rapid rural appraisal (RRA) survey also will be conducted to identify constraints to CA adoption. 100 farmers will be surveyed for behavioral change at the level of the selected platform.

#### Milestones

| Milestones: | Completion dates | Persons in charge |
|---|---|---|
| a.Review of existing documentation | Oct. 2012 | Boughlala |
| b. Conduct a RRA | Nov. 2012 | Boughlala and project team |
| c. Sampling | Dec. 2012 | Boughlala and project team |
| d. Questionnaire elaboration | Feb. 2013 | Boughlala |

| | | |
|---|---|---|
| e. Questionnaire testing & adjustment | Mar. 2013 | Boughlala |
| f. Survey implementation | May 2013 | Boughlala and project team |
| g. Data cleaning & entry | Jun. 2013 | Boughlala |
| h. Data analysis & reporting | Oct. 2013 | Boughlala and project team |

### 1.2.3. Tunisia

#### Team in charge

| Name | Time allocated |
|---|---|
| Boubaker Thabet (INAT) | 10% |
| Maâroufi Hayet (INGC) | 20% |
| Raja Nabli (INGC) | 10% |

#### Justification

On the basis of the survey data, and possibly by adding rapid rural appraisal targeted data searching, the attempt will be made to analyze the constraints perceived by farmers to the CA adoption process.

#### Objective

The objective is to contribute to the spirit of objective one of this project from the start which aims at delineating the constraints to CA adoption. An updating of the weights of these constraints will take place as the project goes on.

#### Methods

- Conduct statistical analyses of the parametric and non-parametric types for the sake of determining the driving factors of adoption.
- Develop an optimization model to analyze the possible integration of livestock and field crop activities under CA regime for a typical farm to be selected on the basis of the survey data
- Compute investment ceiling levels in farm machinery for the main farm types to be determined based on the survey.

#### Measurements

- Survey data information and other available secondary data.

#### Milestones

- Full report of the activity to be submitted detailing :
  - Preliminary information on the weights of constraints to CA Adoption
  - Investment ceiling information in farm machinery for different farm types
  - Participation in national workshop

#### Inputs

- Required logistics:
  - Acquisition of 3 laptops (one to be used at INAT and 2 at INGC) with high storage capacity and high processing capacity and high random access memory.
  - 3 printers
  - Consumables (paper, flash disks, External disk drives)

        - Office supplies
- Software:
    - 1 multi-site econometrics software (review)
    - 1 multi-site optimization software (LINGO)

**Budget (for two activities 1.1&1.2)**

See budget table

**Planning (for activities 1.1&1.2)**

| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Mai | Jun |
|---|---|---|---|---|---|---|---|---|---|
| Choice of farmers | | | | | | | | | |
| Questionnaire elaboration & circulation | | | | | | | | | |
| Questionnaire testing & adjustment | | | | | | | | | |
| Survey implementation | | | | | | | | | |
| Data cleaning & entry | | | | | | | | | |
| Data analysis & reporting | | | | | | | | | |
| Annual report delivered & National workshop | | | | | | | | | |
| Parallel behavioral studies | | | | **** | **** | **** | **** | *** | |

# 2. Objective 2. To identify and test improvement in seeding machinery, and in weed and biomass management of CA systems

*Operational coordinator: Dr. Jacques Desbiolles (Australia)*

## 2.1. Sub-objective 2.1. Develop and test affordable ZT seeding machinery and crop establishment systems for small to medium sized farms

### 2.1.1. Activity 2.1.1.Conduct ZT seeder international inventory and select suitable low-cost options for available and potential power sources in the selected platforms

**Team in charge**

| Institutions | Staff | %TIME |
|---|---|---|
| Morocco | | |
| INRA | O. El-Gharras | 2 |
| | A. El Aissaoui | 5 |
| AGENDA | Azzedine El Brahim, | 2 |
| | N. El Han Atoui | 5 |
| Tunisia | | |
| INGC | M. Jadlaoui | 30 |
| | M. Ali Hannachi | 5 |
| ESIER | Hassan kharoubi | 5 |
| Algeria | | |
| PMAT | Harrad Fatiha | 10 |
| ITGC | Ghalem Youcef | 10 |
| | Laouar Abdelmalek | 5 |
| ATU | Makhlouf Mahfoud | 10 |
| ICARDA | (PTC) | |
| RSSA | J. Desbiolles (UniSA) | 30 |
| Partners: Farmers | | |
| Input suppliers e.g. importers | | |

**Justification**

In the short/medium term, low cost, small-scale imported seeders (targeted price range $10000) are likely to be a key source of ZT seeders effectively sustaining adoption of CA by small/medium holder farmers.

**Objectives**

- To produce an inventory of affordable and suitable ZT seeders, commercially available for the partner countries.

- To acquire a selection of best-bet low-cost ZT seeders for the project.

### Methods

Contacts of key machinery international suppliers (including Australia, Turkey, Jordan, Europe, Iran etc.) will be reviewed by the team and selected specifications will be acquired in a standardized fashion. Key criteria for inclusion of potential seeders will be: price <$10k approx. ex-works, suitable for 55-75HP tractors, 2-3m width.

Three seeders will be considered as an indicative base per platform: (budget is $30k each)

Report of potential seeders including recommendations for purchase by project mid Dec 2012

Orders placed Feb13 – delivery July 13:

### Expected outputs

- Knowledge of lower cost ZT seeders available on the international market
- 9 ZT seeders (3 types in each country) acquired by the project, with expected potential for adoption in the platforms and commercial distribution within the countries

### Milestones

| Milestones: | Completion dates | Persons in charge |
|---|---|---|
| Develop a common seeder specification collection form | Oct 2012 | Machinery team |
| Develop a contact list of potential suppliers | Nov 2012 | Machinery team |
| Acquire seeder data from suppliers | Jan 2013 | Machinery team |
| Compile information into report with recommendations for purchase | Feb2013 | Machinery team |
| Order and purchase seeders in partnership with potential machinery importers | Feb 2013 | ICARDA – Machinery team |
| Reception of seeders in each country and workshop checks | August 2013 | ITGC, INRA, INGC |
| Using protocol developed in 2.1.3., conduct initial laboratory/field tests on pre-calibration and functionality (visual assessments) | November 2013 | ITGC, INRA, INGC |

### Budget: Up to $30 000 for three seeders

**Seeder specification form**

Seeder pictures
front/back/side

Brand name:
Model
Country of manufacture:
Factory address:
Tel:
Email:
Contact person: (position)
Key criteria
Indicative cost (US$) ex-works: …………………..
Tractor horsepower range: …………………..
Seeding width: …………………..
Selected specifications
A) FRAME
Seeder hitch: towed / 3PL (cat 1-2)
Seeder weight (empty), kg: ………………
Transport width, m: ……………………..
B) HOPPERS
Hopper: simple/double
Capacity (L): seeds: ………… fertilizer: ……………
C) SEEDING SYSTEM:
Disc or tine opener
Row spacing (cm): …………… (Adjustable ?) Y / N
Number of openers:
Number of ranks: ………… Distance between ranks (m): ……..
D) METERING SYSTEM:
Roller type: fluted, peg tooth, others: ……………………
Adjustment means: gear box, lever, sprockets, and roller flap
Range of crops sown:
Small seeds: ………………………………………
Medium seeds: …………………………………….
Large seeds: ……………………………………….
Seed rate min-max (wheat reference): ………………kg/ha
E) OPTIONS AVAILABLE (extra cost):
Press wheels: Y/N details: ……………………………
Disc coulters Y/N details: …………………………….
Others: ……………………………………………………..

### 2.1.2. Activity 2.1.2.Review existing conventional drills available in the target core countries and develop improvements to enable ZT seeding

**Team in charge**

| Institutions | Staff | %TIME |
|---|---|---|
| Algeria | | |
| PMAT | Harrad Fatiha | 10 |
| ITGC | Ghalem Youcef | 10 |
| | Laouar Abdelmalek | 5 |
| | Oumedjekane Kahina | 15 |
| | Bouhaouchine Larbi | 10 |
| University | Djennene Abdelmadjid | 15 |
| ATU | Makhlouf Mahfoud | 10 |
| | | |
| Morocco | | |
| INRA Settat | O. El Gharras | 5 |
| | M. Boughlala | 5 |
| | A. El Aissaoui | 5 |
| FST Settat: | Pr H. Fassi Fihri | 5 |
| | M. Tabia | 15 |
| CT Settat | N. El Hantaoui | 5 |
| CT Oued Zem | M. Nazih | 1 |
| | | |
| Tunisia | | |
| INGC | M. Jadlaoui | 10 |
| | M. Ali Hannachi | 20 |
| | Hayet Maroufi | 5 |
| ESIER | H. Kharroubi | 5 |
| RSSA | J. Desbiolles (UniSA) | 5 |
| Partners: Farmers | | |
| Input suppliers, e.g. service providers, manufacturers | | |

## Justification

Most of the time, no-till seed drill availability and cost is the principal reason given by farmers for low adoption or no-adoption of no-till and CA. Lowest cost ZT seeder (=modification of existing seeder base) is likely to be a key aspect of low-risk adoption of zero-till seeding – e.g. at an entry level - for farmers or service providers owning conventional seeders. A survey on mechanization aspects is required to reveal the machinery related constraints and opportunities present in the project areas and assist with the process to enhance adoption.

## Objectives

- To assess the state of mechanization level at the platform level (tractors, seeders, sprayers).

- To identify the models of machinery maintenance/repairs (local repair workshops) and identify potential partners in the project.
- To identify the model of access to mechanization by the farmers in the project areas (mechanized farmers, service providers).
- To identify seeder owners willing to engage in seeder upgrade within the project methodology (e.g. old seeder to be dedicated to project, upgraded by project and made available to farmer&community for ZT seeding).
- To identify the most representative seeders in the platform and of those, the ones technically modifiable under a lowest cost approach.
- To implement seeder upgrade and pre-testing in collaboration with industry partners.

## Method

- See main survey protocol – additionally:
- Interview with questionnaire (enumerators to include machinery-aware person)
- Acquire pictures of machinery
- Include 20% of farmers (formerly or currently) practicing ZT to effectively identify the actual constraints to adoption experienced so far (e.g. including why any dis-adoption?)
- Target population must have enough representation of ‘machinery owners’ (farmers, service providers) – e.g. For Morocco: all machinery owners to be surveyed in the region of Chaouia-Ouadigha, and “30%” of surveyed population outside this area (while still in the same agro-ecological platform) to be machinery owners.

## Notes:

All interviewees will be surveyed to address Obj: 3 above

Machinery owners (Farmers and service providers) will additionally be surveyed to address Obj: 1, 2, and 4 above.

## Expected outputs:

- An improved understanding of the status of mechanization in each platform.
- Effective partnerships with collaborating partners (farmers, service providers, local workshops, manufacturers).
- Best-bet conventional seeders upgraded and with confirmed functionality, for evaluation in project activities.

## Milestones

| Milestones: | Completion dates | Persons in charge |
|---|---|---|
| Develop questionnaire and rationale | Mid October 2012 | Machinery team |
| Integrate within main survey questionnaire and pre-testing | Mid-Dec 2012 | Socio-Economic team in collaboration with machinery team |
| Conduct survey | Feb 2013 | Socio-Economic team |
| Debug and analyse and interpret mechanization data | Mar2013 | Socio-Economic team in collaboration with machinery team |
| Identify suitable seeders and potential collaborators | April 2013 | Machinery team |
| Develop report on mechanization component | June 2013 | Socio-Economic team in collaboration with machinery team |
| Upgrade 1 selected seeder | September 2013 | machinery team in collaboration with industry partners |

| | | |
|---|---|---|
| Using protocol developed in 2.1.3., conduct initial laboratory/field tests on pre-calibration and functionality (visual assessments) | November 2013 | machinery team |
| Upgrade other selected seeder(s) if applicable | September 2014 | machinery team in collaboration with industry partners |
| Conduct similar laboratory/field tests on pre-calibration and functionality (visual assessments) if applicable | November 2014 | machinery team |

**Budget:** see table.

## Suggested questionnaire machinery component

Questions listed by objectives:

1) To assess the state of mechanization at the platform level (Tractors, seeders, sprayers)

Type of machinery present

- Tractor: brand model HP, age, Hydraulic 3PL, mechanical condition, etc. (for each tractor)
- Seeder: brand, model, width, age, mounted or towed, mechanical condition, etc. (for each seeder)
- Sprayer: brand, type, age, mechanical condition, used for what? (for each sprayer)

2) To identify the models of machinery maintenance/repairs (local repair workshops, on-farm) and identify potential partners in the project

Machinery maintenance/repairs

- Who maintains the machinery? (Contact details if not farmer)
- Describe maintenance operations
- Who repairs the tractor? (Contact details if not farmer)
- Describe type of tractor repairs
- Where do the spare-parts come from (name and contact details?)

For local workshops only:

- Interested in collaborating on the manufacture of a modification kit for a local seeder?
- Identify capacity to manufacture (what do they make?) inc. repair, maintenance

3) To identify the models of access to mechanization by the farmers in the platform areas (mechanized farmers, service providers)

For machinery owners:

- How do they use their tractor/seeder/sprayer (own use only?, fee for service only?, both ?)

Seeders:

- Cost per ha for contracted seeding in 2012?
- Area for own seeding in 2012 (ha)
- Area for contracted seeding in 2012 (ha)
- Who is the contracted seeding done for? (how many clients and which clients)

For non-machinery owners:

- How do they access the tractor/seeder/sprayer equipment for their use? (Neighbor farmer, contractor)
- Cost of seeding / ha in 2012`? (identify if service exchange rather than purchase)
- Area sown by contracted tractor&seeder in 2012 (ha)

4) To identify seeder owners (within the experimental areas) willing to engage in seeder upgrade within the project methodology (e.g. old seeder to be dedicated to project, upgraded by project and made available to farmer & community for ZT seeding)

- Are you interested in dedicating one seeder to the project ? (Modified by the project and made available to the farmer AND to surrounding farmers) etc.. (explain expectations)
- Identify which seeder could be available

### 2.1.3. Activity 2.1.3.Design and test a new ZT drill prototype to meet key specifications identified in the target platforms

### Team in charge

| Name | Time Allocated |
|---|---|
| Algeria | |
| Harrad Fatiha (PMAT) | 10 |
| Ghalem Youcef (ITGC) | 10 |
| Makhlouf Mahfoud (ATU) | 10 |
| Laouar Abdelmalek (ITGC) | 5 |
| Morocco | |
| O. El Gharras (INRA) | 20 |
| A. El Aissaoui (INRA) | 5 |
| H. Fassi Fihri (FST Settat) | 5 |
| M. Tabia (FST Settat) | 15 |
| E. Bourrarach (IAV) | 10 |
| M. Idrissi (ATMAR) | 5 |
| Tunisia | |
| M. Jadlaoui (INGC) | 30 |
| M. Ali Hannachi, (INGC) | 5 |
| Hayet Maroufi, (INGC) | 5 |
| Dr H. Kharroubi (ESIER) | 20 |
| J. Desbiolles (RSSA/UniSA) | 10 |
| Partners: Farmers, AGENDA | |
| Input suppliers (e.g. service providers, manufacturers | |

### Justification

The unavailability of locally adapted low-cost ZT seeders is a major reason limiting the adoption of zero-tillage in the Maghreb. Locally developed and produced ZT drill options made available to farmers of at an affordable cost is proposed as one strategy in the project. Development activities need to include improving the design to achieve reliable performance in a range of field conditions and to support its commercial adoption.

### Objectives

- To design a new basic seeder based on the Syrian simple tine seeder concept while considering all recommended improvements following the pilot testing conducted during the 2011/12 season.
- To identify and partner with manufacturers that are interested in the prototype seeder industrial development
- To validate seeder functionality and develop pre-calibration tables/curves
- To evaluate the field performance in a range of soil/residue/crop conditions and identify the preferred conditions of use for the seeder.

### Methodology

A seeder concept will be developed using as much as possible existing equipment/components already manufactured locally. Requirements for modifications will be identified in developing the design, and design solutions will be finalized in close partnership with industry. Specialized components (metering system, tines…) may be purchased at least initially from outside the country, as best suit, to lower the seeder cost. Existing test protocols from RNAM, FAO, and ASABE will be reviewed in the process of developing a seeder testing procedure.

### Expected outputs

- New locally manufactured seed drills prototype evaluated for functionality, with identified suitability levels over a range of soil/residue/crop conditions

### Milestones

| Milestones: | Completion dates | Persons in charge |
|---|---|---|
| To identify existing equipment and components (locally manufactured) that can be integrated in a seeder concept | November 2012 | Machinery team |
| To identify and source the components that need to be purchased | November 2012 | Machinery team |
| Design a seeder prototype and develop a set of manufacturing drawings | March 2013 | Machinery team |
| Manufacture of seed drill prototype in collaboration with industry partner(s) | September 2013 | Machinery team |
| Develop protocols for initial laboratory and field performance assessment | September 2013 | Machinery team |
| Conduct initial laboratory/field tests on pre-calibration and functionality (visual assessments) | October 2013 | Machinery team |
| Improve seeder design as required in targeted adaptive field research trials over selected soil/residue/crop conditions | September 2014 | Machinery team |

**Budget:** field testing costs

### 2.1.4. Activity 2.1.4.Undertake field performance assessment of a range of ZT drill options for successful crop establishment in relevant CA cropping contexts

#### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | O. EL GHARRAS, | 15 |
| | A. EL AISSAOUI | 5 |
| IAV Hassan II | E. BOURRARACH | 5 |
| FST Settat | H. Fassi FIHRI | 5 |
| RSSA | J. Desbiolles (UniSA) | 10 |
| AGENDA | A. EL BRAHLI | 2 |
| Partners: ATMAR | M. IDRISSI | 5 |
| Input suppliers | | |

#### Justification

Adoption of ZT seeders - either imported or newly manufactured in-country - and of upgraded existing seeders require some dedicated field testing activities to reach a suitable level of confidence on seeder performance prior to undertaking demonstration and promotion activities within the platforms (as part of Obj. 2.2, 2.3). Activities 2.1.1, 2.1.2.and 2.1.3. have resulted in the availability of ZT seeders of various potentials and price range. This activity will aim to recommend the preferred contexts of use and guide their promotion/adoption process.

#### Objectives

- To evaluate and improve the field performance of modified existing seeders over a range of soil/residue/crop conditions and identify their preferred context of use
- To evaluate the field performance of new imported ZT seeders over a range of soil/residue/crop conditions and identify their preferred context of use
- To evaluate and improve the field performance of new locally manufactured ZT seeders over a range of soil/residue/crop conditions and identify their preferred contexts of use
- Develop suitable operator and spare parts manuals, including best practice recommendations for use of ZT seeders

#### Methodology

Field testing will where possible be aligned with components of existing protocols such as RNAM, FAO, and ASABE. A relevant selection of soil/crop/residue conditions will be considered in each platform for the field experiments to enable recommended contexts of use for satisfactory performance to be clearly identified. Best practice recommendations will be developed for their use as promising options at the farmer managed demonstration sites.

#### Expected outputs

- Evaluated ZT seeder performance in a variety of soil/residue/crop conditions
- ZT seeder units adoptable by small holder farmers in recommended contexts of use identified
- Machinery partners planning to meet market demand of adoptable seeders

## Milestones

| Milestones: | Completion dates | Persons in charge |
|---|---|---|
| Develop protocol of comparative seeder field experiments (data focus on seeding quality and crop establishment /vigour /yield) | January 2013 | machinery team |
| Develop operator and spare parts manuals for the new locally manufactured ZT seeder(s) | January 2013 | M. TABIA |
| Conduct field testing of ZT seeders over a range of soil/residue/crop conditions on-farms outside the project research/demonstration areas | June 2013 | E. BOURRARACH |
| Develop recommendations on best practice and preferred contexts of use for the various ZT seeder options and develop plans for use in project demonstration trials | September 2014 (on-going to September 2015 as applicable) | E. BOURRARACH |

**Budget:** Operating costs/travel to sites etc… to be determined with IAV partners.

### 2.1.5. Activity 2.1.5.Engage local manufacturers and farmers in the development, manufacture and promotion of low cost appropriate ZT machinery options

## Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | O. EL GHARRAS,<br>A. EL AISSAOUI,<br>M. BOUGHLALA | 5<br>5<br>5 |
| AGENDA | Azzedine El BRAHLI,<br>N. EL HANTAOUI | 1<br>5 |
| ATMAR | M. IDRISSI | 10 |
| RSSA | J. Desbiolles (UniSA) | 5 |
| ICARDA | | |
| Partners: retailer | COMICOM; M. YACOUBI & K. MOUSTATI,SCOPIM;AutoHall;StockVis; | |
| Input suppliers | | |

## Justification

Successful development and adoption of ZT/CA systems requires a process of participatory and co-learning approaches involving all stakeholders. In the development of ZT seeders, manufacturers need to be closely involved to ensure lowest costs and good understanding of the field performance requirements are achieved, and farmer demand for adapted ZT seeders is ultimately met. The features of ZT seeders need to take into account the perceptions and experiences of farmers, and the field performance must directly meet their expectations. Partnering with committed and well established machinery importers is also needed to ensure the availability of suitable ZT seeders is able to meet any emerging demand.

### Objectives

- To ensure participatory stakeholder involvement in the development, supply and promotion of ZT seeder solutions for small holder farmers.

### Methods

Consultation at key stages with farmers and involvement in all aspects of seeder development with manufacturers in particular will be promoted. Feedback on seeder performance will also form part of the participatory co-learning process.

### Expected outputs:

- Prototype new ZT seeders manufactured by partner at own cost
- Farmers involved in the evaluation and promotion of ZT /CA systems
- Machinery partners meeting market demand of adoptable seeders in timely fashion
- Successful adoption rate of ZT seeders in the platform areas

### Milestones

| Milestones: | Completion dates | Persons in charge |
|---|---|---|
| ZT farmer consultation on key issues experienced with ZT seeders (2-10 day events in collaboration with AGENDA) | January 2013 | O. EL GHARRAS, M. BOUGHLALA |
| Manufacturer engagement with new ZT seeder development – effective dialogue and co-contributions from concept and design solutions to manufacture to field evaluation and commercialization | On-going, September 2012, 13, 14, 15 | O. EL GHARRAS, A. EL AISSAOUI, M. BOUGHLALA |
| Importer/distributor engagement with new ZT seeder importing and field evaluation – Effective dialogue and demonstrated commitment | On-going, September 2013, 14, 15 | O. EL GHARRAS, A. EL AISSAOUI, A. EL BRAHLI |
| Local workshop engagement on ZT modification kits for existing seeders – from design solutions to manufacturing and evaluation – Effective dialogue and demonstrated commitment | On-going, September 2013, 14, 15 | O. EL GHARRAS, A. EL AISSAOUI, M. BOUGHLALA, M. IDRISSI |
| Involvement of farmer groups (via AGENDA) in the comparative ZT seeder field evaluation – effective dialogue | September 2014 | A. EL BRAHLI, N. EL HANTAOUI, M. BOUGHLALA |

**Budget:** Operating costs (travel mainly)

## 2.2. Sub-objective 2.2. Fine-tune weed management and crop sequences for sustainable land & water management

### 2.2.1. Activity 2.2.1. Study the dynamics of weeds and develop an integrated management for weed control under CA systems, including consideration of herbicide resistance

### *2.2.1.1. Algeria*

## Research team

| Name | Time allocated |
|---|---|
| Djennadi Farida. | 10 % |
| Laouar Abdelmalek. | 10 % |
| Fortas Bilal | 5 % |
| Bendada Hocine | 5 % |
| Makhlouf Mahfoud | 5 % |
| Benlakehal Zahra | 5 % |
| Chaou Lydia | 10 % |

## Justification

AC systems based on crop rotation and low soil disturbance and surface combined with integrated control against weeds is the best way to reduce the number, biomass and seed weeds

However, it is necessary to have a thorough knowledge of the composition and dynamics of weeds within an agro-ecosystem.

## Objective

Study the dynamics of emergence and growth of weed populations for development an integrated management of weeds in CA system

## Methodology

Test control weed options in three on-farm researcher-managed trials)and test best solutions in 20 on-farm managed trial (demonstration).

- Trial 1: Comparative study of ZT seeders existing locally (modified drill with a drill type) on the level of infestation by weeds and improving the performance of the wheat crop in the region of Setif,
- Trial 2: Effect of chemical weeding on weed control in wheat in triennial rotation (lens or chickpea / wheat / barley) conduct in CA.
- Trial 3: Effect of planting date and chemical control against weeds in wheat resulted in conservation agriculture in Setif region.

**Theme 1: Comparative study of ZT seeders existing locally (modified drill with a drill type) on the level of infestation by weeds and improving the performance of the wheat crop in the region of Setif.**

**Purpose of the test**

The difference in the width of overture the furrow in seeders directly modified (e.g. drill Syrian) induced warming and greater disturbance of soil over a width exceeding 10 cm distance along the seed row, which generates a weed emergence largest on the seeding line with the rest of the field. This comparative study will enable to:

- Highlighting adaptation of modified seeders ZT to agro ecological region of Setif and its effect on the level of infestation by weeds;
- Highlighting the performance of modified seeders ZT compared with type ZT seeder with regard to weed infestation;

- Highlight the effect on the behavior and performance of wheat crop driving in CA.

**Sites implementation**

3 sites = 3.2 ha(Khababa :0.8 ha, Boukari :1.2 ha, SAGRODEV :1.2 ha)

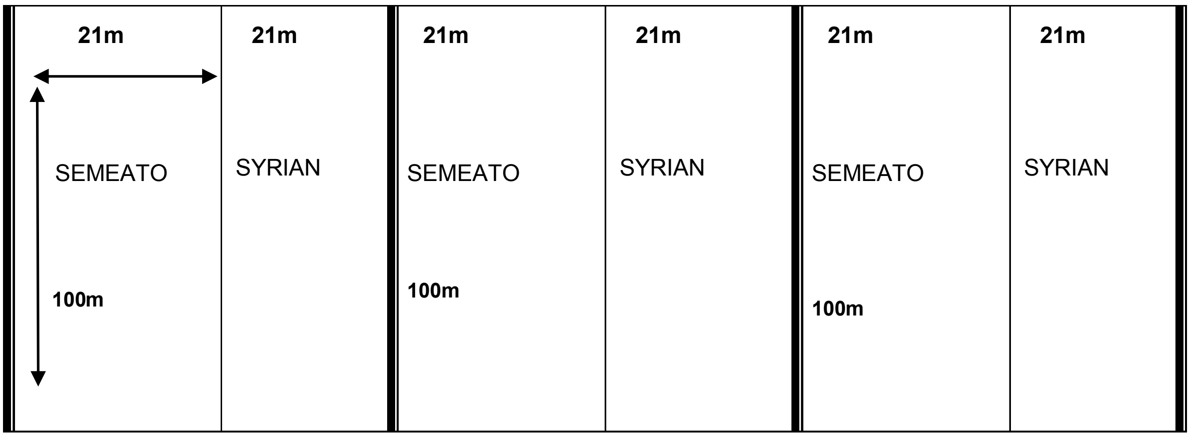
**Experimental Protocol**

3 strips of comparison for Boukari, SAGRODEV and 2 strips for Khababa

Factor studied: one factor "machine type" at 2 levels:

- T1: Sowing done with a modified seeder ZT (Syrian or SOLA)
- T2: Sowing made with a seeder type for ZT (Semeato or Kuhn)
- Elementary plot size: 100 m X 42m = 4200 m².
- Dimensions of the test plot: 12600 m².

**Experimental plan**




Measurements

Notations on the state of the field before planting

- Chemical analysis of the soil;
- Soil conditions at planting (moisture, apparent density and porosity, friability, stoniness and compaction);
- Condition of residues (types, coverage ground in %);
- Previous crop;
- Problem Weed of the previous crop (with photos).

Conduct of the test

- Species, Variety;
- Thousand grain weight;
- Germination in%;
- Sowing date;
- Dose seed (kg / ha) in the laboratory;
- Fertilization background (date / stage, type, dose);
- Nitrogen first contribution (date / stage, type, dose);
- Nitrogen second contribution (date / stage, type, dose);

- Total weeding (date / stage, type, dose);
- Weeding post emergence (date / stage, type, dose);
- Diseases chemical treatment (date, type, dose);

Notation on the machine (at planting)

Performance indicators are measured for each drill;

- Density seeding on site kg / ha;
- Rate of fertilization on site kg / ha;
- Row Spacing;
- Depth and width of opening furrow;
- Speed seeding;
- Sowing depth and location of seeds;
- Observations on the closure of the furrows.

* Record observations on the performance of drill (problems or constraints) and press with photos.

Notation on weeds

- Identification of weeds at the onset of each phenological stage of the wheat crop in the seed row and the rest of the plot (with photos taken);
- Level of infestation broadleaf each phenological stage of the crop using the rating scale Baralis;
- Level of infestation grass each phenological stage of the crop using the rating scale Baralis;
- Density of weeds/m² (grass and broadleaf) to the end of winter, at elongation stage and heading stage by the most important species on five plots of 1m ².

Notation on culture

- Number of emerged plants / m² plots at homogeneous;
- Evaluation of the emergence rate (%);
- Observation on seedling vigor;
- Depth of sowing;
- Dry matter at anthesis / m²;
- Densities of weeds (grass and broadleaf);
- Components of yield and yield (grain and straw);
- Rate of grain harvest (%).

Evaluation of costs per hectare

- Duration of seeding operation;
- Cost of seeding operation (seed, labor and fuel);
- Cost of chemical treatments (products and fuel, labor);
- Cost of fertilization operations (products and fuel, labor).

**Theme 2: Effect of chemical weeding on weed control in wheat in triennial rotation (lentils or chickpea / wheat / barley) conduct in CA.**

**Purpose of the test**

The elimination of plowing in CA system results in difficulties in weed control and the systematic use of glyphosate for weed control before planting, will undoubtedly lead to emergence of herbicide resistant ecotypes.

This experiment will allow us to establish a schedule of chemical weed control, taking into account the biology of weeds existing at the example plot.

Annual weeds should be controlled in the seedling stage, alternating between active materials and respecting rotation to avoid inversion of plant, using doses and application method suitable to optimize the effectiveness of herbicides selected.

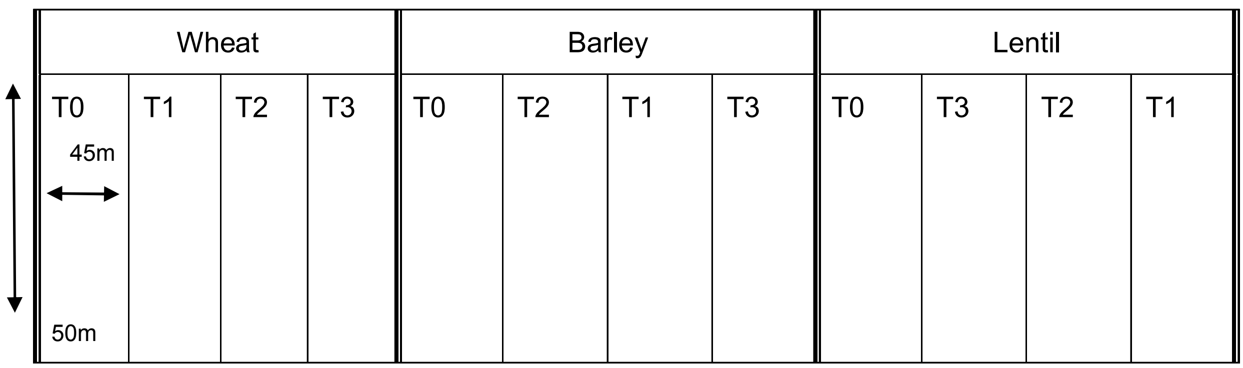
For perennials, must maintain their low density possible by the use of total herbicides when necessary This test allows us to highlight:

- The effect of chemical weed control on reducing level of infestation by weeds in wheat conduct in CA,
- The effect of rotation on reducing the level of infestation by weeds in wheat conduct in CA
- The effect of rotation combined with chemical weed control on reducing the level of infestation of wheat in CA
- The effect of rotation combined with chemical weed control on improving the behavior and performance of wheat conduct in CA

**Sites Implementation**

4 sites = 9.45 ha(Khebaba : 1.35 ha, Tabhirt : 2.7 ha,Dahel : 2.7 ha, Koli : 2.7 ha)

**Experimental plan**




**Wheat trial**

Factor studied: one factor with 4 levels of herbicide.

Treatments studied:

- T0: Control not weeded;
- T1: Weeding glyphosate only;
- T2: Weeding glyphosate + early weed control at three-leaf stage with Pallas OD;
- T3: Weeding glyphosate + early weed control at three-leaf stage with Pallas OD + weeding remedial spring (Granstar +Traxos).

**Barley trial**

Factor studied: one factor with 4 levels of herbicide.

Treatments studied:

- T0: Control not weeded;

- T1: Weeding glyphosate only;
- T2: Weeding glyphosate + early weed control at three-leaf stage with Dopler;
- T3: Weeding glyphosate + early weed control at three-leaf stage with Dopler + weeding remedial spring against broadleaf weeds, with Zoom.

**Lentil Trial**

Factor studied: one factor with 4 levels of herbicide.

Treatments studied:

- T0: Witness not weeded;
- T1: Weeding glyphosate only;
- T2: Weeding glyphosate + post sowing weed control with GESAGARD or Basagran;
- T3: Weeding glyphosate + post sowing weed control with GESAGARD or Basagran + remedial weeding against monocotyledonous with the shooting.

**Measurements**

Notations on the status of the parcel before sowing

- Condition of residues (types, coverage ground in %);
- Previous crop;
- Problem Weed of the previous crop (press with photos).

**Conduct of test**

- Species, Variety;
- Thousand grain weight;
- Germination in%;
- Sowing date;
- Dose seed (kg / ha) in the laboratory;
- Fertilization background (date / stage, type, dose);
- Nitrogen first contribution (date / stage, type, dose);
- Nitrogen second contribution (date / stage, type, dose);
- Total weeding (date / stage, type, dose);
- Weeding post emergence (date / stage, type, dose);
- Diseases chemical treatment (date, type, dose);
- Complement Irrigation (number of irrigation, date / stage of crop and dose).

**Notation on weeds**

- Identification of weeds before each weeding (with photos taken);
- Identification of weeds that have escaped the herbicide effect (with photos taken);
- Level of infestation of the plot by dicots and monocots before any type of chemical weed control using the rating scale Baralis;
- Level of infestation of the plot by dicots and monocots after 20 days, 3 and 6 weeks after each weeding using the rating scale;
- Density of monocotyledonous weeds / m² before the application of early weeding the 3-leaf stage and before spring remedial weeding by species most important (ryegrass, wild oats, canary, bromine) on 5-1m ² plots;
- Dicotyledonous weed density / m² to 20 days 3 to 6 weeks after the application of early weeding at 3 leaf stage and remedial weeding in spring, for the most important species (Cleavers, the mustard fields, thistle, mallow and field bindweed) on 5 plots of 1m ².

**Notation on crop**

- Number of emerged plants / m² plots at homogeneous
- Evaluation of the emergence rate (%);
- Observation on seedling vigor;
- Depth of sowing;
- Dry matter at anthesis / m²;
- Densities of weeds (grass and broadleaf);
- Components of yield and yield (grain and straw);
- Rate of grain harvest (%).

**Theme 3: Effect of planting date and chemical control against weeds in wheat resulted in conservation agriculture in Setif region.**

**Trial objective**

In conventional agriculture a delay of several days in the planting season combined with the practice of stale seedbed technique is an effective control against weeds that have lifted together in time. This test allows defining:

- The effect of planting date on weed control in wheat, driving in CA;
- The effect of chemical weeding on weed control in wheat driving in CA;
- The combined effect of planting date and chemical weed control on weed control in wheat driving in CA;
- The combined effect of planting date and chemical weed control on improving the behaviour and performance of wheat CA driving.

**Sites Implementation**

4 sites = 6.3 ha (Khababa: 0.9 ha, Dahel: 1.8 ha, Tabhirt:1.8 ha, Koli :1.8 ha)

Plot size of the test: 18000m ²

Factors studied: one factor with 4 levels herbicide.

**Treatments studied**

- T0: Witness not weeded;
- T1: Weeding glyphosate only;
- T2: glyphosate weeding + early weed control at three-leaf stage with Pallas OD;
- T3: glyphosate weeding + early weed control at three-leaf stage with Pallas OD + remedial Spring weeding with Granstar and TRAXOS.

**Measurements:**

Notations on the status of the parcel before sowing

- Condition of residues (types, coverage ground in %);
- Previous crop;
- Problem Weed of the previous crop (press with photos).

**Conduct of test:**

- Species, Variety;
- Thousand grain weight;
- Germination in%;
- Sowing date;

- Dose seed (kg / ha) in the laboratory;
- Fertilization background (date / stage, type, dose);
- Nitrogen first contribution (date / stage, type, dose);
- Nitrogen second contribution (date / stage, type, dose);
- Total weeding (date / stage, type, dose);
- Weeding post emergence (date / stage, type, dose);
- Diseases chemical treatment (date, type, dose);
- Complement Irrigation (number of irrigation, date / stage of crop and dose).

**Notation on weeds**

- Identification of weeds before each weeding (with photos taken);
- Identification of weeds that have escaped the herbicide effect (with photos taken);
- Level of infestation of the plot by dicots and monocots before any type of chemical weed control using the rating scale Baralis;
- Level of infestation of the plot by dicots and monocots after 20 days, 3 and 6 weeks after each weeding using the rating scale;
- Density of monocotyledonous weeds / m² before the application of early weeding the 3-leaf stage and before spring remedial weeding by species most important.
- (Ryegrass, wild oats, canary, bromine) On 5 1m ² plots;
- Dicotyledonous weed density / m² to 20 days 3 to 6 weeks after the application of early weeding at 3 leaf stage and remedial weeding in spring, for the most important species (Cleavers, the mustard fields, thistle, mallow and field bindweed) on 5 plots of 1m ².

**Notation on culture**

- Number of emerged plants / m² plots at homogeneous
- Evaluation of the emergence rate (%);
- Observation on seedling vigor;
- Depth of sowing;
- Dry matter at anthesis / m²;
- Densities of weeds (grass and broadleaf);
- Components of yield and yield (grain and straw);
- Rate of grain harvest (%).

**Notation on diseases and pests**

- Major fungal diseases on leaf, stem and root (stage appearance and severity);
- Attacks aphids or other insects on leaf, stem and root (stage appearance and degree of infestation);
- Estimate the damage induced by sparrows.

**Evaluation of costs per hectare**

- Cost of chemical treatments (products and fuel, labor).

## Milestones

- Report on dynamics of weeds at crop sequence on the on farm trials.
- Options of weed management (herbicide, rotations and sowing date) tested in 4 on farm researcher managed trials.

## Inputs needed

***Theme 1: Comparative study of ZT seeders existing locally (modified drill with a drill type) on the level of infestation by weeds and improving the performance of the wheat crop in the region of Setif (area 3.2 ha)***

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed R1 | 3.2 ha x 1,4q = 4.48 q |
| Basic fertilizer TSP (1q/ha) | 3.2 ha x 1q =3.2 q |
| Fertilizer coverage (Urea 1q/ha) | 3.2 ha x 1 q = 3.2 q |
| Glyphosate (3.5 liter / ha) | 3.2 ha x 3.5 l = 11.2 l |
| Post emergence herbicide (Pallas OD 0.5 liter / ha) | 3.2 ha x 0.5l = 3.2 l |
| Fungicide (Artea 0.5 liter/ha) | 3.2 ha x 0.5 l =1.6 l |
| Supplemental irrigation | 3.2 ha |
| Seeding 1,4 q | 3.2 ha x 1,4 q = 4.48 q |
| Chemical treatment of seed | 2 kg |
| Bag for production (seeds of next campaign) | 84 bags |
| Transport seed 10 ha | 42 q |
| Triage seed | 42 q |
| Treatment seed harvested (Divident dose 200 ml/ql) | 200 ml x 42 q =8,4 l |
| Treatment seed harvested (operation) | 42 q |
| Acquisition of a camera | 20 000 |
| Acquisition of a kit for protection against pesticides | 20 000 |
| Recharge card for telephone to communicate with farmers | A recharge card of 1000 AD / 2 months |

***Theme 2: Effect of chemical weeding on weed control in wheat in triennial rotation (lentils or chickpea / wheat / barley) conduct in CA (9.45 ha) .***

Wheat plot

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed R1 | 3.15 ha x 1,4 q= 4,41 q |
| Basic fertilizer TSP (1q/ha) | 3.15 ha x 1 q =3.15 q |
| Fertilizer coverage (Urea 1q/ha) | 3.15 ha x 1 q = 3.15 q |
| Glyphosate (3.5 liter / ha) | 2.36 ha x 3.5 l =8.27 l |
| Post emergence herbicide (Pallas OD 0.5 liter / ha) | 1.575 ha x 1 l = 1.57 l |
| Post emergence herbicide (Granstar) | 0.7875 ha x 15 g =11.81 g |
| Post emergence herbicide (Traxos) | 0.7875 ha x 1l/ha = 0.7875 l |
| Fungicide (Artea 0.5l/ha) | 3.15 ha x 0.5 =1.575 l |

| | |
|---|---|
| Supplemental irrigation | 3.15 ha |
| Seeding | 3.15 ha x 1,4 q= 4.41 q |
| Chemical treatment | 2 kg |
| Bag for production (seeds of next campaign) | 112 bags |
| Transport seed 10 ha | 56 q |
| Triage seed | 56 q |
| Treatment seed harvested(Divident dose 200 ml/ql) | 200 ml x 56 q =11,2 l |
| Treatment seed harvested (operation) | 56 q |

Barley plot

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed R1 | 3.15 ha x 1,4q= 4.41 q |
| Basic fertilizer TSP (1q/ha) | 3.15 ha x 1q =3.15 q |
| Fertilizer coverage (Urea 1q/ha) | 3.15 ha x 1 q = 3.15 q |
| Glyphosate (3.5 liter / ha) | 2.36 ha x 3.5 l = 8.268 l |
| Post emergence herbicide(Dopler) | 1,575 ha x 2 l/ha = 3,15 l |
| Post emergence herbicide (Zoom) | 0,787 ha x 120 g/ha = 94,44 g |
| Fungicide (Artea 0.5 liter/ha) | 3.15 ha x 0.5 =1.575 l |
| Supplemental irrigation | 3.15 ha |
| Seeding | 3.15 ha x 1,4 q=4.41 q |
| Chemical treatment of seed | 2 kg |
| Bag for production (seeds of next campaign) | 112 bags |
| Transport seed | 56 q |
| Triage seed | 56 q |
| Treatment seed harvested(Divident dose 200 ml/ql) | 200 ml x 56 q =11,2 l |
| Treatment seed harvested (operation) | 56 q |

Lentil plot

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed | 3,15 ha x 1 q= 3,15 q |
| Basic fertilizer TSP (1q/ha) 4600 AD | 3,15 ha x 1 q =3,15 q |
| Glyphosate (3.5 liter / ha) | 2,3625 ha x 3,5 l = 8,268 l |
| Post emergence herbicide(Gésagard) 3,5 liter/ha | 1,575 ha x 3,5 l/ha = 5,512 l |
| Post emergence herbicide(Fusillade) | 0,7875 ha x 1 l/ha = 0.7875 l |

| | |
|---|---|
| Fungicide (Artea 0,5 liter/ha) | 3,15 ha x 0.5 =1,575 l |
| Supplemental irrigation | 3,15 ha |
| Seeding | 3,15 ha x 1,4q = 4,41 |
| Chemical treatment | 2,0475 ha |
| Bag for production (seeds of next campaign) | 112 bags |
| Transport seed | 56 q |
| Triage seed | 56 q |
| Treatment seed harvested(Divident dose 200 ml/ql) | 200 ml x 56 q =11,2 l |
| Treatment seed harvested (operation) | 56 q |

***Theme 3: Effect of planting date and chemical control against weeds in wheat resulted in conservation agriculture in Setif region (6.3 ha).***

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed R1 | 6,3 ha x 1,4 q= 8,82 q |
| Basic fertilizer TSP (1q/ha) | 6,3 ha x 1 q =8,82 q |
| Fertilizer coverage (Urea 1 q/ha) | 6,3 ha x 1 q = 8,82 q |
| Glyphosate (3,5 liter / ha) | 4,725 x 3,5 l = 16,53 l |
| Post emergence herbicide(Pallas OD 0.5 liter / ha) | 3,15 ha x 1 l = 3,15 l |
| Post emergence herbicide(Granstar) | 1,575 ha x 15 g = 23,625 g |
| Post emergence herbicide (Traxos) | 1.575 ha x 1l/ha = 1.575 l |
| Fungicide (Artea 0.5l/ha) | 6,3 ha x 0.5 =3.15 l |
| Supplemental irrigation | 6,3 ha |
| Seeding | 6,3 ha x 1,4 q= 8,82 q |
| Chemical treatment | 2 kg |
| Bag for production (seeds of next campaign) | 112 bags |
| Transport seed | 56 q |
| Triage seed | 56 q |
| Treatment seed harvested(Divident dose 200 ml/ql) | 200 ml x 56 q =11,2 l |
| Treatment seed harvested (operation) | 56 q |

## Budget

(see table budget)

## Planning

| | Oct | | | Nov | | | Dec | | | Jan | | | Feb | | | Mar | | | Apr | | | Mai | | | Jun | | | Jul | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Farmers choice | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Soil sampling | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| Weed flora initial determination | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| Glyphosate treatment | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| Crop seeding | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |
| Post-emergence herbicide treatment (early weed control) | | | | | | X | X | X | | | | | | | | | | | | | | | | | | | | | | |
| Determination of weed density | | | | | | | | X | X | X | | | | | | | | | | | | | | | | | | | | |
| Post-emergence herbicide treatment (remedial Spring weeding) | | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | |
| Determination of weed density | | | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | |
| Crop Yield | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |

### *2.2.1.2. Morocco*

## Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| AGENDA: | A. TANJI, | 10 |
| | A. EL BRAHLI | 5 |
| INRA Marrakech: | B. HAJJAJ | 10 |
| RSSA: | | |
| ICARDA | | |
| Partners: Farmers | | |
| Input suppliers, e.g. service providers | | |

## Justification

Weeds are major constraint to crop production in rain fed areas. They use water, nutrients, and light; thus they reduce crop yield. Integrated weed management using appropriate rotation and herbicides is therefore necessary to conserve soil moisture and increase crop production.

## Objectives

- To assess the soil seed bank before planting with no till drill.
- To identify weeds and monitor weed emergence before planting and after crop emergence.
- To monitor crop growth without weeds and with weeds
- Apply the appropriate options for weed control in CA in the region.
- To evaluate weed control techniques used in each crop before planting and after crop emergence.
- To estimate yield loss due weeds
- To identify weed problems for further effort in succeeding years

## Method

- Take soil samples to estimate soil seed bank at each site before planting
- Monitor weed density from planting to crop maturity in weedy plots and treated plots
- Monitor crop and weed shoot biomass from planting to crop maturity in weedy plots and treated plots
- Harvest grain and straw crops in weedy plots and treated plots

## Expected output

- An improved understanding of weed dynamics and weed management.

## Milestones

| Milestones | Completion dates | Persons in charge |
|---|---|---|
| Estimate soil seed bank | October 2012 | Weed science team |
| Monitor weed emergence, density and biomass, and crop biomass from planting to crop maturity in weedy plots and treated plots | Oct 2012-May 2013 | Weed science team |
| Harvest crops in weedy plots and treated plots | May 2013 | Weed science team |
| Analyze and interpret weed management data, write a report | May-June 2013 | Weed science team |

**Budget:** Travel support (cars, fuel, per diem) site visits – additional to main survey:

***Suggested questionnaire weed management component***

Questions by objectives:

To assess the state and cost of weed management

Type and cost of weed management

- Herbicides: product, rate, crop stage, weed stage,
- Backpack or tractor sprayer: brand, type, age, water, mechanical condition, operator protection
- Labor for manual weeding: gender, time, crop stage, weed stage, cost,

### 2.2.1.3. Tunisia

#### Research team

| Name | Time allocated |
|---|---|
| Thouraya Souissi (Leader, INAT) | 20 % |
| Hatem Cheikh M'hamed (INRAT) | 10 % |
| Salah Ben Youssef (INRAT) | 5 % |
| Messaad Khamassi (INGC) | 30% |
| Houcine Angar (INGC) | 10 % |
| Naima Ben Bahri (INGC) | 30% |

#### Objective

Study the dynamics of weeds and develop an integrated management for weed control under CA systems, including consideration of herbicide resistance.

#### Methodology

- Four farm sites
- Site direct seeded (no-till)
- Experimental design: strip plot design with two factors: row spacing and chemical herbicide treatments.
  - Crop: Faba Bean.. The trial will be done within a crop rotation wheat/Faba bean to evaluate effect of herbicide next years.

Main plot (1ha): row spacing. Two row spacing are tested: 34cm and 51cm. 51 cm is the common row spacing used by farmers in conventional system, but in CA system we recommend to use 31 cm to reduce weed competition with Faba bean

- 
- Sub-plots (12m x 100m): chemical herbicides. Three options involving three different herbicide combinations applied at different timing of weed emergence (PRE and POST emergence herbicides).
- Herbicide treatments for Faba Bean will be:
- T1: AgriSimazine ( Simazine 1.5l/ha, post seedling – pre-emergence) + Select Super (clétodhime 1l/ha, at 3 leaf stage )
- T2: Stompaqua (Pendiméthaline 1.8l/ha , post seedling – pre-emergence + select super (clétodhime 1l/ha, at 3 leaf stage )
- T3: AgriSimazine ( Simazine 1.5l/ha, post seedling – pre-emergence) + Select super (clétodhime 1l/ha, at 3 leaf stage ) + Basagran (Bentazone 1.25 l/ha at 3 leaf stage )

The quantitative survey of the farms is conducted to determine the weed frequency and relative density of most dominant weed species using quadrate method. The quadrate used is 1M × 1M. Six quadrates are randomly thrown at all subplots. The frequency percentage and RDP of different weed species is calculated using the following formula:

**Frequency (%)** = (No. of quadrates in which weed species occurred) x 100 / Total No. of quadrates laid out

**Relative density (%)** = (Mean No. of individual weed species in quadrates) x 100 / No. of individuals of all weed species in quadrates.

### Measurements

Weed growth is monitored and compared in the different options. Weed problems will also be identified for further effort in succeeding years.

- Crop and weed emergence
- Weed densities (5 periods)
- Weed frequencies
- Weed biomass
- Crop yield

### Milestones

- Options of weed management tested in 4 on farm researcher managed trials.
- Report on weed dynamics and biomass at 4 farms
- Integrated weed management guidelines
- Best options verified in 20 farmer-managed trials
- A guide for weed management

| Crop | Seeds (kg) | DAP (kg) | Sulfate de potassium (kg) | Ammonium Nitrate (kg) |
|---|---|---|---|---|
| Faba Bean | 400 | 400 | 400 | -- |
| Wheat | 800 | 400 | -- | 1600 |

### Inputs needed

- Seeds and fertilizers
- Pesticides

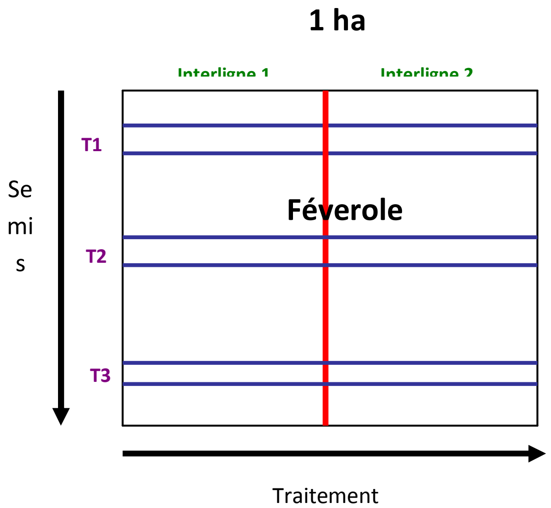
| Pesticides | Faba Bean | Wheat |
|---|---|---|
| Decis | 2L | |
| Amistar | 4L | -- |
| Benco | 8kg | -- |
| Opus | -- | 4L |
| Ogam | -- | 4L |
| Glyphosate (2L/ha) | 8L | 8L |
| Amilcar OD (1L/ha) | -- | 4L |
| Agrisimazine (1.5L/ha) | 6L | -- |
| Select Super (1L/ha) | 4L | -- |
| Stompaqua (1.8L/ha) | 5L | -- |
| Basagran (1.25L/ha) | 5L | -- |
| TOTAL | | |

### Budget

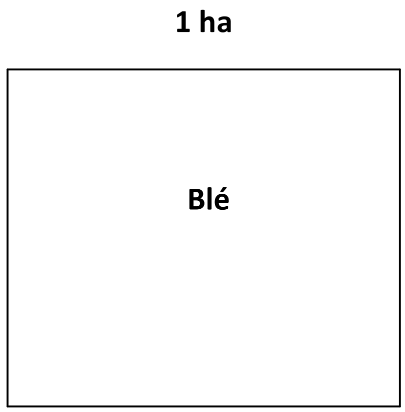
(see table budget)

## Planning

| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | Mai | Jun | Jul |
|---|---|---|---|---|---|---|---|---|---|---|
| Farmers choice | ■■ | | | | | | | | | |
| Soil sampling | | ■□ | | | | | | | | |
| Weed flora initial determination | | ■□ | | | | | | | | |
| Glyphosate treatment | | ■□ | | | | | | | | |
| Crop seeding (faba bean and wheat) | | ■■ | | | | | | | | |
| Herbicide treatments (Pre-emergence) | | ■□ | | | | | | | | |
| Determination of weed density and frequency | | | ■□ | | | | | | | |
| Herbicide treatment (Post-emergence) | | | □■ | ■□ | | | | | | |
| Determination of weed density and frequency | | | | | ■□ | □■ | ■□ | □■ | ■□ | |
| Crop Yield (Faba bean and wheat) | | | | | | | | ■■ | ■■ | |




***CANA Project: Integrated Weed Management Trial***




***Données:***

1 Glyphosate: 1 week before sowing date
2 Culture: Féverole
3 Interligne 1: 34cm
4 Interligne 2: 51cm

**Traitements:**

T1: simazine + Select super
T2: stompaqua+ Select super
T3: simazine + select super + Basagran
5 Width per traitement : 9m or 12m
(dépend de la rampe de pulvérisation)

## 2.2.2. Activity 2.2.2. Test crop sequence options to enhance diversification and sustainable productivity

### *2.2.2.1. Algeria*

### Team in charge

| Scientist name | Time allocated |
|---|---|
| Djennadi Farida | 15 % |
| Laouar Abdelmalek | 10 % |
| Fortas Bilal | 5 % |
| Bendada Hocine. | 5 % |
| Makhlouf Mahfoud | 5 % |
| Benlakehal Zohra | 5 % |
| Hafsi Miloud | 10 % |
| Rahim Zahia | 10 % |

### Justification

Improved cropping systems with Introduction and mastery of new possible rotations for better adoption of CA

### Objective

Tests of possible rotations AC to improve soil fertility, weed management, ensure a permanent soil cover and provide new resources to operate while reducing fallow.

### Methodology

Adapted species introduced and tested in rotation (Biennial rotations) with cereal crops dominant in 4 farms. The tests are set up with the wheat and barley grown in rotation with legumes, forage and oilseed crops. Promising rotation solutions are verified in 20 farmers.

Theme of trial: Study the effect of different types of rotation on reducing weeds infestation in wheat, conducted in CA.

***Test purpose***

Crop rotation has a significant and positive impact on the biological activity of the soil and plant nutrition

- It helps to break the life cycle of agricultural pests.
- The succession of plants from different families and different periods of growth can break the cycle of certain weeds
- Alternating herbicides molecules reduces the risk of resistance and makes it easier to manage long-term weed.
- With different root systems, the soil profile is better explored, resulting in improved soil physical characteristics including its structure (by reducing compaction and soil degradation). The water supply and the ability to explore the soil cultures are thus improved.
- Employment of legumes allows the addition of symbiotic nitrogen in the soil.

### *Site Implementation*

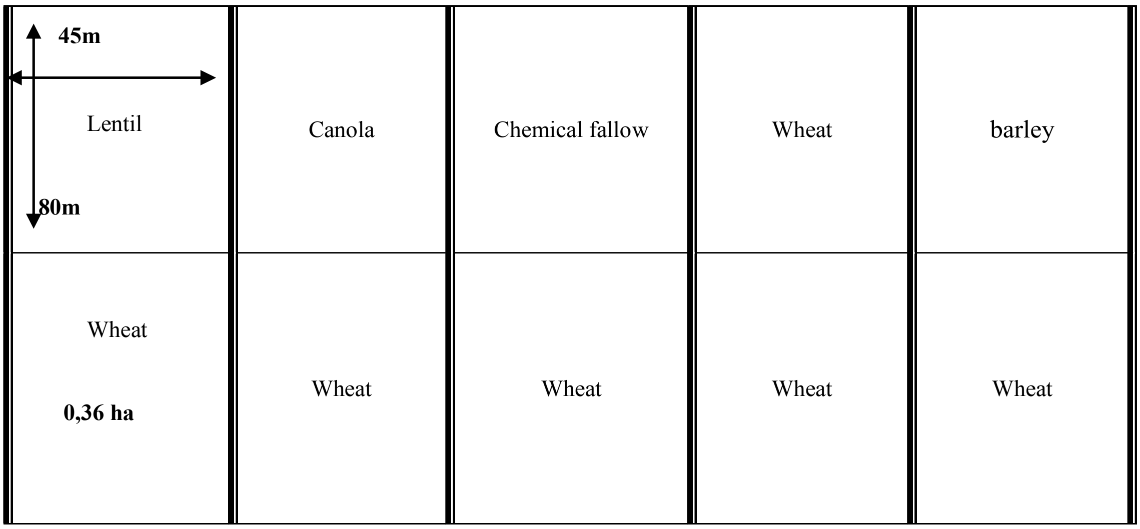
4 Sites = 16 ha(Smata: 4 ha, Mansouri: 4 ha,Laidi: 4 ha, Louali: 4 ha)

### *Experimental Protocol*

Factor studied: one factor rotation with 5 levels.

- T0: Wheat /Wheat
- T1: Lentil /Wheat
- T2:Canola /Wheat
- T3: Chemical fallow /Wheat
- T4: Barley/Wheat

### *Experimental plan*




This form of the trial would give us information from the second year both for wheat and for the other crops. Many data, notations and parameters could be continuously studied in the both two blocks (Objective 2.2.3). Since we are conducting the trial in different yearly weather conditions, It would be a good test for the ZT system in the response of these crops. We would also have a diversification in production from the first and for the following years,

### *Measurements*

Notations on the status of the parcel before sowing

- Condition of residues (types, coverage ground in %);
- Previous crop;
- Weed problemof theprevious crop(press with photos).

Conduct of test

- Species, Variety;
- Thousand grain weight;
- Germination in%;
- Sowing date;
- Dose seed (kg / ha) in the laboratory;
- Fertilization background (date / stage, type, dose);

- Nitrogen first contribution (date / stage, type, dose);
- Nitrogen second contribution (date / stage, type, dose);
- Total weeding (date / stage, type, dose);
- Weeding post emergence (date / stage, type, dose);
- Diseases chemical treatment (date, type, dose);
- Complement Irrigation (number of irrigation, date / stage of crop and dose).

Notation on weeds

- Identification of weeds do at the onset of each phenological stage of the wheat crop
- Level of infestation by broadleaf plot to each phenological stage of the crop using the rating scale Baralis
- Level of infestation of the plot by monocots to each phenological stage of the crop using the rating scale
- Density of weeds / m² to the end of winter, the bolting stage and heading stage by the most dangerous species on five plots of 1m ²

Notation on culture

- Number of emerged plants / m² plots at homogeneous
- Evaluation of the emergence rate (%);
- Observation on seedling vigor;
- Depth of sowing;
- Dry matter at anthesis / m²;
- Densities of weeds (grass and broadleaf);
- Components of yield and yield (grain and straw);
- Rate of grain harvest (%).

Notation on diseases and pests

- Major fungal diseases on leaf, stem and root (stage appearance and severity);
- Attacks aphids or other insects on leaf, stem and root (stage appearance and degree of infestation);
- Estimate the damage induced by sparrows.

## Milestones

- Establish plots of promising adapted species (legumes, oilseeds and forages) on 4 farms and observe the effects on the succeeding cereal crops.

## Inputs needed

Wheat plot (8.64 ha)

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed R1 | 8.64ha x 1,4 q=12,096 q |
| Basic fertilizer TSP (1q/ha) | 8.64ha x 1q =8,64 q |
| Fertilizer coverage (Urea 1q/ha) | 8.64 ha x 1 q = 8,64 q |
| Glyphosate (3.5 liter / ha) | 8.64 ha x 3.5l = 30,24 l |
| Post emergency herbicide(Pallas OD 1 liter / ha) | 8.64 ha x 1 l = 8,64 l |
| Fungicide (Artea 0.5 liter/ha) | 8.64 ha x 0,5 l = 4,32 l |

| | |
|---|---|
| Supplemental irrigation | 8.64 ha |
| Seeding | 8.64 ha x 1,4 q = 12,096 q |
| Chemical treatment | 3 KG |
| Bag for production (seeds of next campaign) | 112 bags |
| Transport seed | 56 q |
| Triage seed | 56 q |
| Treatment seed harvested(Dividend dose 200 ml/q) | 200 ml x 56 q =11,2 l |
| Treatment seed harvested (operation) | 56 q |

Lentil plot (1.44 ha)

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed | 1.44 ha x 1q=1,44 q |
| Basic fertilizer TSP (1q/ha) | 1.44 ha x 1q =1,44 q |
| Glyphosate (3.5 liter / ha) | 1.44 ha x 3,5l = 5,04 l |
| Post emergency herbicide(Gésagard 3,5 liter/ha) | 1.44 ha x 3,5l = 5,04 l |
| Post emergency herbicide (Fusillade 0,75 liter/ha) | 1.44 ha x 0,75 l = 1,08 l |
| Fungicide (Artea 0.5 liter/ha) | 1.44 ha x 2 l = 2,88 l |
| Supplemental irrigation | |
| Seeding | 1.44 ha x 1q = 1.44 ha |
| Chemical treatment | 0.5 KG |
| Bag for production (seeds of next campaign) | 84 bags |
| Transport seed | 42 q |
| Triage seed | 42 q |
| Treatment seed harvested(Dividend dose 200 ml/q) | 200 ml x 42 q = 8,4 l |
| Treatment seed harvested (operation) | 42 q |

Barley plot (1.44 ha)

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed R1 | 1.44 ha x 1.4q=2.016 q |
| Basic fertilizer TSP (1q/ha) | 1.44 ha x 1q =1.44 q |
| Fertilizer coverage (Urea1q/ha) | 1.44 ha x 1 q =1.44 q |
| Glyphosate (3.5 l / ha) | 1.44 ha x 3.5l = 5.04 l |
| Post emergency herbicide(Dopler) | 1.44 ha x 2 l/ha = 2.88 l |
| Post emergency herbicide (Zoom) | 1.44 ha x 120 g/ha = 172.8 g |

| | |
|---|---|
| Fungicide (Artea 0.5liter/ha) | 1.44 ha x 0.5 =0.72 l |
| Supplemental irrigation | 1.44 ha |
| Seeding 3000 AD | 1.44 ha x 1.4 q=2.016 q |
| Chemical treatment | 0.5 KG |
| Bag for production (seeds of next campaign) | 112 bags |
| Transport seed | 56 q |
| Triage seed | 56 q |
| Treatment seed harvested(Dividend dose 200 ml/q) | 200 ml x 56 q =11.2 l |
| Treatment seed harvested (operation) | 56 q |

Canola plot (1.44 ha)

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed | 1.44 ha x 7 kg = 10.08 kg |
| Basic fertilizer TSP (2 q/ha) | 1.44 ha x 2 q =…2.88 q |
| Fertilizer coverage (Urea 2 q/ha) | 1.44 ha x 2 q = 2.88 q |
| Potassium K2O ( 100 Unit) | 1.44 ha x 2 q = 2.88 |
| Glyphosate (3.5 l / ha) | 1.44 ha x 3.5l = 5.04 l |
| hoeing (3 times) | 1.44 ha x 3 = 4.32 ha |
| Supplemental irrigation | 1.44 ha |
| Seeding | 1.44 ha |
| Treatment seed harvested(Dividend dose 200 ml/q) | 0.8 q x 200 ml/q = 160 ml |
| Treatment seed harvested (operation) | 0.8 q |

Chemical fallow (1,44 ha)

| Inputs | Quantity |
|---|---|
| Lime(tracing) | 60 kg |
| Glyphosate (3,5 liter/ha) | 1.44 ha x 3.5l = 5.04 l |

## Planning

| | Oct | | | Nov | | | Dec | | | Jan | | | Feb | | | March | | | April | | | May | | | June | | | July | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Farmers choice | X | X | X | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Soil sampling | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| Weed flora initial determination | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| Glyphosate | | | | | X | X | | | | | | | | | | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| treatment | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Crop seeding | | | | | X | X | X | | | | | | | | | | | | | | | | | | | | | | | |
| Monitoring of soil moisture | | | | | X | X | X | | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | |
| Post-emergence herbicide treatment | | | | | | | X | X | | | | | | | X | X | | | | | | | | | | | | | | |
| Determination of weed density | | | | | | | | X | X | X | | | | | | X | X | | | | | | | | | | | | | |
| Crop Yield | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | X | |

### *2.2.2.2. Morocco*

**Theme 1. Test Crop sequence options to enhance diversification and sustainable productivity**

## Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| AGENDA | A. EL BRAHLI, | 10 |
| | B. TANJI | 5 |
| INRA | O. ELGHARRAS, | 3 |
| | M. EL KOUDRIM, | 3 |
| | B. EL YOUSFI, | 10 |
| | O. IBENHALIMA, | 4 |
| | Z. ABAIL, | 5 |
| | M. BOUGHLALA | 1 |
| RSSA | A. MAYFIELD | |
| CT Oued Zem | A. NAZIH | 1 |
| ICARDA | (PTC) | |
| Partners: Farmers | | |
| Input suppliers/importers | | |

## Introduction

Oued Zem, project target area is located in East central plain of Chaouia /Ouardigha. It is characterized by low rainfall (300-350 mm) and cereal/livestock integration production system. Wheat and barley are the main crops grown for grain and grazed when drought and insufficient rain occur. Continuous cereals, removal of all surface biomass and grazing whatever residues left in the field led to various crop growth constraints such as a buildup of weeds, diseases and diverse population of pests. Intensive tillage operations for seed bed preparation exacerbate the soil losses by erosion and reduce its fertility to a less than one percent soil organic matter. Recommendation based on crop intensification mainly using certified seeds and substantial fertilizer and pesticides seem not giving satisfactory result. Farmers are facing high inputs cost and inadequate rationalization of chemical fertilizer and pesticide applications. Such farming issues in this area are of high risk investment that speed up and contribute to farmer's debt and poverty. Unsustainable production is preserved mainly by livestock activities canalized for religious feast event, government subsidies and external parallel incomes support ensured by immigrants' household members.

## Objectives

The main objective is to improve the conventional farming system to a conservation agricultural system adapted to agro climatic prevailing conditions and the economic changes.

Emphasis is put in no till system with crop rotation management that increase water use efficiency and reduce production cost. Researcher managed trail will be established in three locations differentiated mainly by soil depth and crop /livestock shared activity of the farmers.

## Methodology

The particularity of this activity is the involvement of a multidisciplinary team dealing with different aspects of crop management in the same trail. The trail will be replicated in 4 farmers' field.

### Crop rotation

In each location proposed crop rotations and a traditional wheat/barely rotation will be compared and evaluated under not till management. Proposed rotations are:

- Bread wheat/ Forage crop (mixture of vetch and oat)
- Bread wheat/Canola (new cash crop)
- Bread wheat/Legumes (food legume grain pea).

### Crop managements

Proposed innovations:Farmers recently adopting no till remain reticent in changing their behavior in crop management. The innovations in this experiment will be to increase water use efficiency by eliminating tillage, reducing seeding rate for different crops, improving soil fertility and enhancing pest control by adopting appropriate crop rotation. The following table shows the proposed treatments:

***Seeding rates (plant population)***

| Crops | Farmer rate of seeding<br>Rate per hectare | Improved rate<br>Rate per hectare |
|---|---|---|
| Wheat | 180 kg | 100 kg |
| Barely | 150 kg | 80 kg |
| Forage mixture | Oat (100 kg/ha) | Vetch 70kg/ha + Oat (30kg/ha) |
| Legume peas | 120 kg of local variety | 100 improved variety |
| Canola | 10 kg | 6 kg |

***Fertilization***

In each site, soil profile characterization on the first year and its evolution at year four of the project is the first step to evaluate the soil biological, physical and chemical changes under no till system.

Evaluation of crop needs and soil available nutrients will be conducted before planting time. Nitrogen amendment will be monitored and quantified needs will be applied along the cropping season based on rainfall pattern in different sequence of the crop rotation.

The proposed recommendation will be applied also in adjacent farmer managed. Change in soil fertility will be evaluated in different crop sequences.

***Pest management***

Monitoring differences in disease infestation and insects mainly hessian flies by repeated observations and sample harvesting in order to make appropriate decision of pesticides need and applications. Untreated check for foliar fungicides application and disease incidence will be evaluated.

Non selective pre-planting herbicide application will be made only on years of significant early rainfall.

In forage crop sequence plots will be split in two treatments to evaluate the contribution of weed to the total biomass produced in terms of quantity and quality.

Survey and samples of weed species in each sequence will be evaluated before herbicide application. Evolution of weed population will be also monitored by evaluating seed bank and emerged weeds. Broadleaves herbicide will be applied in respect to possible soil carry over, weed resistant and maintaining the biodiversity of the system mainly in wheat/forage crop sequence.

Plot size: Total field experiment of four hectares where each sequence will be layout in area of one hectare (wheat/barley and wheat/other crops)

***Corresponding Farmer platforms***

Farmer platforms will be scattered on Chaouia-Ouardigha with main focus on Oued Zem region where 50 % of the platforms will be established. One of the three rotations under no till system will be established in famer field and will be compared to farmer main rotation adjacent to the improved famer managed rotation.

Data to be collected

- Weather data, daily high and low temperature, amount of rainfall and duration
- N, P, K and OM status
- Plant emergence and established crop density and performance of no-till drill
- Weeds density and biomass
- Wheat Yield component
- Forage biomass, dry weight , nutrition analysis (RFV relative feed value, crude protein, energy , digestibility)
- Grain and straw yields
- Quantity of Residue left after harvest and straw bale removal, residue left at planting time.
- Water balance from planting to harvest and percent soil humidity at planting time.

## Milestones

| Milestones | Completion dates | Persons in charge |
|---|---|---|
| Initial Soil characterization of sites | Oct 2012 | Soil team |
| Weed seed stock | Nov 2012 | Weed science team |
| Rotation established | Nov 2012 | All team members |
| Water status | June 2013 | Soil team |
| Crop, weed and pest monitoring | June 2013 | Agronomy & machinery and soil science members |
| Yield performance | June 2013 | Agronomy & Economic members |

**Theme 2. Response of wheat to N and P within various rotations under no-tillage system**

## Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | Z. ABAIL, | 5 |
| | O. IBEN HALIMA, | 5 |
| | M. EL GHAROUS, | 5 |
| | O. EL GHARRAS | 3 |
| AGENDA | A. EL BRAHLI | 5 |
| RSSA | A. MAYFIELD | 5 |
| ICARDA | (PTC) | |
| Partners: Farmers | | |
| Input suppliers e.g. importers | | |

## Justification

Wheat fertility research program has been concentrating during the last several seasons on proper N, P and K fertilization because of the major role these nutrients play in profitable conventional wheat production, but no concern where given yet to changes happening in soils under no-tillage system. Little is known about how fertilizer management practices should be adjusted to meet wheat nutrient needs in the no till production systems. Indeed, the fertilizer pathways under conventional tillage are different from those under no tillage.

## Objective

The major objective of this study is to evaluate wheat response to N and P within various rotations under no-tillage system.

## Trial management

- Variety; Arrihane or other variety
- Soil type: The most dominant soil type in the region
- Rotations: Wheat- legume, wheat-oil crop, wheat-forage
- Weed control: Glyphosate herbicide to control any standing vegetation prior to planting and in fallow periods.
- Disease control: for septoria control if necessary
- Fertilizing: Nitrogen and phosphorus fertilizers will be applied according to the protocol.
- Potassium fertilizers will be used according to soil test before each crop.

## Experimental plan

- Treatments:
  - Nitrogen rates: 0, 30, 60 and 120 kg N/ha
  - Phosphorus rates: 0, 20, 40 and 80 kg P2O5/ha
  - 4 N x 4 P
  - 16 treatments x 3 replications = 48 plots
- Experimental design: Randomized complete block design
- Plot size: 2.5m x 10 m = 25 $m^2$
- Fertilizer form: Ammonium nitrate (33.5%), Supertriple phosphate (46%)
- Fertilizer application: Broadcast

### Sampling, analysis, experiment observations and recording

- Sampling:
  - Soil sampling: Soil samples to a depth of 60 cm will be obtained from each replication I, II and III before fertilizer application. Four cores per replication will be obtained (12 cores /site). Each core will be subdivided into 20 cm increments.
  - Plant sampling:
  - Seedling at the tillering stage will be sampled from all treatments.
  - Whole plants will be sampled at anthesis stage from all treatments.
  - Grain samples will be obtained at harvest from all plots.
- Analysis
  - Soil analysis: All soil samples will be analyzed for organic matter, nitrogen (total N, NO3-N, and NH4-N, phosphorus (Na HCO3-P NH4 HCO3- DTPA P and CaCl2-P).
  - Some selected samples will be analyzed for pH, EC, K, CaCO3
  - Plant analysis: All samples will be analyzed for total nitrogen and phosphorus
- Climatic data
  - Record the local meteorological data such as daily precipitation, temperatures, relative humidity from October till harvest time.
- Crop data
  - **Crop management data:** including wheat variety, the fertilizer types applied and their nutrient profiles, the time, rate and method of fertilizer application, the sowing time and method, the weeding method and frequency, the harvest time, and other field management measures.
  - **Plant density:** record seedling emergence and plant density at jointing and grain filling stages.
  - **Phenological data:** record dates of growth stages of wheat in each plot: seedling stage, tillering stage, jointing stage, booting stage, grain filling stage and mature stage.
  - **Growth data sampling:** a representative spot of (1x1 m²) in each plot will be chosen for each treatment (1/replicate) for different growth stages (tillering and anthesis). Cut the aerial part of the wheat plants to measure their fresh weight and oven-dry weight.
  - **Harvest data:** the plots will be sampled by taking two 5 m strips from center rows. Cut down the aerial part of wheat and weigh the air-dried total biological and grain yields. Grain, stalks and leaves will be kept from sampling section of each treatment plot for future analysis.

### Statistical analysis of data

Data will be subject to analysis of variance and least significant differences (LSDs) to assess significance of differences among treatments.

### Expected results

- Nitrogen fertilization effect on dry matter yield, grain yield and N uptake is determined.
- Phosphorus fertilization effect on dry matter yield and grain yield is evaluated.
- Combined effect of nitrogen fertilization and crop rotation on wheat yield is determined.
- Combined effect of phosphorus fertilization and crop rotation on wheat yield is shown.
- Changes in soil quality attributes are detected.

### 2.2.2.3. *Tunisia*

## Team in charge

| Scientist name | Institution | Time allocated |
|---|---|---|
| Hatem Cheikh M'hamed (activity coordinator) | INRAT | 20 |
| Salah Ben Youssef | INRAT | 5 |
| Samia Gargouri | INRAT | 5 |
| Mohamed Annabi | INRAT | 5 |
| Sourour Abidi | INRAT | 5 |
| Thouraya Souissi | INAT | 5 |
| Nadthira Ben Aissa | INAT | 5 |
| Houcine Angar | INGC | 20 |
| Anis Bouselmi | INGC | 15 |
| Messaad Khammassi | INGC | 10 |

## Background

In the project targeted region (Fernana), conventional cropping systems are mainly based on the biennial faba bean/wheat rotation carried out on sloppy lands. Most of Fernana small farmers hold a small flock (< 10 heads) of both local fat-tail barbarin sheep and enhanced breeds of cattle for the farmer own consumption.

The main forage resources consist in wheat straw during cold months and wheat stubble grazed over summer and autumn season, purchased low nutritional value oaten hay, natural pastures and forests, and concentrate.

Either wheat or faba bean crops show low levels of grain yield not exceeding 2.5 and 1.5 T.ha-1 for both crops, respectively, due to low soil fertility, high environmental disease pressure, high soil erosion susceptibility, and bad cropping practices adopted over long time (absence of organic amendments, deep ploughing on slop direction, no incorporation of crop residues …).

## Objectives

- To assess the technical feasibility of some crop sequences under local soil and climate conditions of the targeted region under no-till systems.
- To evaluate the effect of new cop sequences on wheat production under no-till system.

## Methodologies

- The study will be conducted in 04 farmer-pilot sites in the delegation of Fernana (Governorate of Jendouba), about 170 km from Tunis (north-western of Tunisia). Fernana is located in sub-humid zones (mean annual rainfall of 700 mm) with an accentuated land slope and soil losses concerns.
- The rotation will be tested are biennial faba bean/wheat, vetch-triticale/wheat, wheat/wheat; both phases each year; cultivated with best crop management. Plot size is about 2500 m² with trial duration of 4 years. Data Analysis will be done by regression procedure.
- These trials will be conducted on existing CA on farm trial since 2 years with 1 ha faba-bean and 1 ha wheat. This year we will crop on the last year wheat field the three crops (faba bean, vetch-triticale and wheat). So for subsequent 4 years we will have every year wheat with three precedent crop.

## Observations and measurements

- Meteorological data (Meteorological automatic station):
  - Daily total solar radiation (MJ/m²/day)
  - Daily minimum and maximum temperature (°C)
  - Vapour pressure (kPa) (measured at about 9:00 A.M.)
  - Daily average wind speed at 2 meter (m/s)
  - Daily total precipitation (mm)
  - Air humidity (%)
  - Dew point temperature (°C)
- Crop residue amount (dry matter) crop before sowing and after harvest
- Soil fertility parameters following (see activity 2.2.3).
- Soil water Balance & Crop Water Uptake (soil moisture following during crop cycles under different soil depth with TDR measurement).
- Determination of water use efficiency.
- Monitoring soil and residue populations of soil-borne pathogens for different rotations under natural conditions and across years (see activity 2.2.3).
- Study the dynamics of weeds (see activity 2.2.1).
- Monitoring crops
- Field observations
  - Emergence date
  - Date of anthesis (wheat)
  - Date of physiological maturity
  - Chlorophyll index by SPAD
- Destructive measurements
  - A quarter of a square meter (0.25 m²) of aboveground biomass will be sampled to measure:
- Number of tillers/plant per square meter (number/m²)
- Plant height
- Leaf area index (m²/m²)
- Dry matter (g DW/m²) of:
  - Leaves
  - Stems
  - Spikes

At physiological maturity 10 samples of10 square meters should be sampled to measure:

- Aboveground biomass (g DW/m²)
- Grain dry mass (g DW/m²)
- Harvest index (g/g)
- Total number of spikes (spikes /m²) for wheat
- Number of kernels per spike for wheat
- 1000-seed weight for wheat
- Nitrogen concentration of aboveground biomass (g N/g DW)
- Grain nitrogen concentration (g N/g DW)

## Inputs needs (year 1)

***Supplies***

| Needs (units) | Area cultivated (ha) | Quantity needed (units) |
|---|---|---|
| seeds | | |
| Triticale commercial cultivar | 1,25 | 200kg |
| Faba bean | 1,25 | 130kg |
| Durum Wheat | 5,25 | 1250kg |
| Hairy vetch | 1,25 | 75kg |
| Pesticides | | |
| Glyphosate (l) | 8 | 24 l |
| Amilcar (g) | 5 | 1650 g |
| basagran (l) | 1 | 2 |
| Doppler (l) | 1 | 2 |
| Select super (l) | 1 | 1 |
| Fertilizers | | |
| Triticale (commercial cultivar) | | |
| Nitrogen (ammonium nitrate) | 1 | 300 kg |
| Di-ammonium Phosphate | 1 | 200 kg |
| Durum Wheat | | |
| Nitrogen (ammonium nitrate) | 5 | 2000 kg |
| Di-ammonium Phosphate | 5 | 1000 kg |
| Total | | |

### *Laboratory Chemicals and analysis*

| | Cost ($) per sample | Number of samples |
|---|---|---|
| pH, texture | 20 | 32 |
| Dray matter | 5 | 200 |
| Grain nitrogen concentration | 15 | 30 |
| Nitrogen biomass concentration | 15 | 45 |
| Yield components | 5 | 100 |
| Physiological and biochemical analysis of plant | 10 | 100 |
| Analysis of grain quality | 10 | 100 |
| Total | | |

### *Outings (year 1)*

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sep | oct | nov | dec | jan | feb | mar | apr | May | Jun | jul | Aug |
| Farmers choice | 1[a] | 1[a] | | | | | | | | | | |
| Trial tracing and staking | | 2[a]2[b] | | | | | | | | | | |
| Trial seeding | | | 4[a]2[b] | | | | | | | | | |
| Monitoring of pesticides and herbicides | | | | 2[a] | 2[a] | 2[a] | 2[a] | 2[a] | 2[a] | | | |
| Monitoring of fertilizer | | | | | 1[a] | 1[a] | 1[a] | 1[a] | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monitoring of soil moisture | | | | $1^a1^b$ | $1^a1^b$ | $1^a1^b$ | $1^a1^b$ | $1^a1^b$ | $1^a1^b$ | | | |
| Dray matter sampling | | | | $2^a1^b$ | $2^a1^b$ | $2^a1^b$ | $2^a1^b$ | $2^a1^b$ | $2^a1^b$ | | | |
| Harvest | | | | | | | | | | $4^a4^b$ | | |
| Final soil sampling | | | | | | | | | | $4^a4^b$ | | |
| Total | $50^a + 24^b$ | | | | | | | | | | | |

$^{a:}$ Researcher; $^b$: Technician

**Budget** (see table budget)

## Milestones/timeline achievement

- Determination of crop sequence effect under conservation agriculture system on soil fertility, water use efficiency, carbon sequestration and plant health.
- Study and optimization of some crop rotation under conservation agriculture system on small farmer
- Compilation and analysis of the results and data, publication of prominent results in peer review journal.
- Provide valuable no-till research information and diffusion of information obtained to farmers to accelerate their update/adoption of profitable conservation agriculture.

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sept | oct | nov | dec | jan | feb | mar | apr | May | Jun | jul | Aug |
| Farmers choice | ■ | ■ | | | | | | | | | | |
| Trial tracing and staking | | ■ | | | | | | | | | | |
| Trial seeding | | | ■ | | | | | | | | | |
| Monitoring of pesticides and herbicides | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Monitoring of fertilizer | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | |
| Monitoring of soil moisture | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Dray matter sampling | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Harvest | | | | | | | | | | ■ | | |
| Final soil sampling | | | | | | | | | | ■ | | |

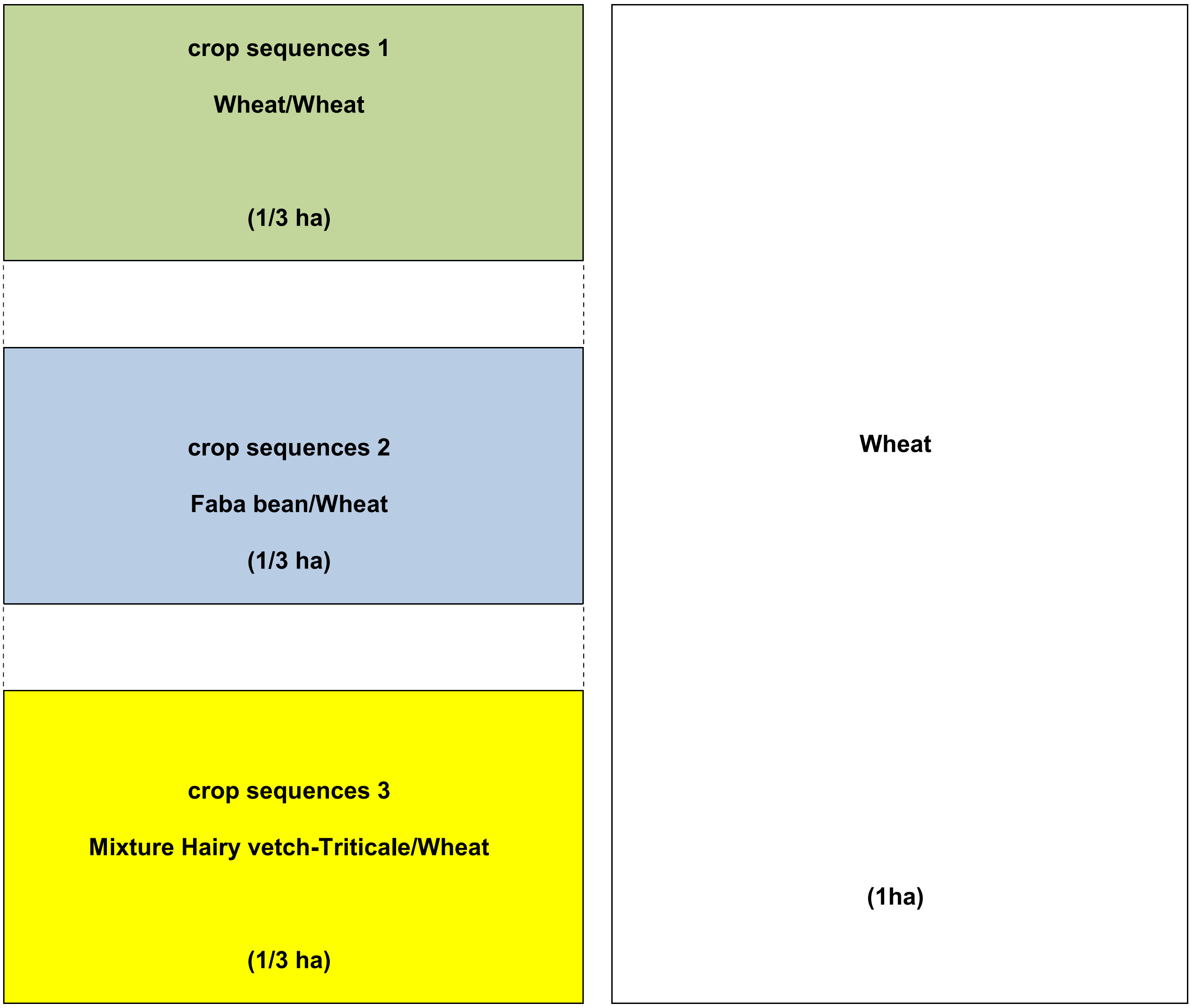



**Fig. 2. Experimental design of the crop sequences options trial (at one farm = one block).**

### 2.2.3. Activity 2.2.3. Assess soil quality/ health and water productivity under CA system

*2.2.3.1. Algeria*

**Team in charge**

| Scientist name | Time allocated |
|---|---|
| Siad Djamila | 30% |
| Saidi Lila | 10 % |
| Amriche Atef Alla Eddine | 25 % |
| Taieb Djamila | 10 % |

## Justification

The use of rainwater and soil conservation is the major concerns of farmers in Highlands region of Sétif. The introduction of new rotations with cereals to replace fallow in CA systems is seen as an alternative capable of reducing soil degradation, increase the storage capacity of rainwater and improve the efficiency of water use and yields accordingly.

## Objective

Crop and soil management under CA to preserve soil fertility and to improve water use efficiency by crops.

## Methodology

Tests the following parameters: organic matter, humidity, and soil erosion (structural stability) in crop rotation trials in 4 farms (s/objective 2.2.2), including the relationship between grain yield and dry matter cultures and water use efficiency.

### Measures

- Conditions of soil before sowing (moisture, apparent density and porosity, friability, stoniness and compaction)
- Monthly soil moisture (every 15 days in the critical stages);
- Penetration index using a penetrometer (at soil field capacity);
- Chemical analysis of the soil before planting or after each harvest;
- Followed by the fertility of the soil immediately after planting to monitor the effect of fertilization, four samples taken per plot surface and sub-surface to conduct physical and chemical analyzes in the laboratory:
- Granulometry/size (method universal Robinson pipette);
- PH water and pH KCl (pH meter);
- Electrical conductivity EC (Conductivity);
- Organic Matter MO (Anne method);
- CEC (complexometric method);
- Exchangeable Base (atomic absorption spectrophotometer);
- Potassium (atomic absorption spectrophotometer);
- Phosphorus comparable (Olsen);
- Nitrogen (Kjeldahl method);
- Total $CaCo_3$ (Bernard calcimeter);
- Active $CaCo_3$ (Drouineau method).

### Monitoring soil parameters in tests machine type and rotation

- Soil profiles
- Physical and chemical soil analysis for 12 sites at initial stage (before sowing)
- Rotation test
- Physical and chemical soil analysis in : biennial rotation test to fertilization monitoring 5 levels rotation with 3 repetitions - 15 samples / site
- Monitoring soil moisture

## Milestones

- Report on soil organic matter and moisture content and soil erosion in the rotation trials and water use efficiency /productivity.

## Planning

| | Sept | | Oct | | Nov | | Dec | | Jan | | Feb | | Mar | | Apr | | May | | Jun | | Jul | | Aug | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Farmers choice | | | X | X | | | | | | | | | | | | | | | | | | | | |
| Initial soil sampling before sowing | | | | | X | X | | | | | | | | | | | | | | | | | | |
| Monitoring of soil moisture | | | | | | X | X | X | X | X | X | X | X | X | X | X | X | X | | | | | | |
| Monitoringfertilization | | | | | | | | | | | | X | X | | | | | | | | | | | |
| Soil compaction monitoring | | | | | | | | | X | X | | | | | | | | | | | | | | |

## Budget

(see table budget)

### *2.2.3.2. Morocco*

## Trial 1. Monitoring soil health under conservative agriculture

## Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | B. EL YOUSFI | 10 |
| AGENDA | A. EL BRAHLI | 3 |
| ICARDA | (PTC) | 5 |
| Partners: Farmers | | 5 |
| Input suppliers e.g. importers | | |

## Justification

Root rot diseases are major constraints to wheat and barley production, worldwide, especially under conservative agriculture. However, under Moroccan conditions, these diseases are identified as common root rot disease and dry root rot or crown rot, caused by *BipolarissorokinianaFusarium culmorom f. sp. cerealis*, respectively (El Yousfi, 1984). In addition and as soil borne diseases, pythium and rhizocionia spp. are encountered in some fields and may also induce root rots of cereals, though these pathogens are at present considered to be less important. Recently, yield losses due to these diseases had increased into economic levels specially, in areas prone to successive drought stress, and where highly susceptible varieties were adopted. In this regard and during the 2011 cropping season, Gharb regions experienced epidemic levels of root rot disease to the extent that some fields had experienced a total crop failure (Fatihy et al., 2011). On average, yield losses were estimated to be around 13-17% (El Yousfi; 1984), however yield losses of up to 50% were also reported (Mergoum, 1991). As these diseases compromise the plants root systems they interact with moisture stresses and with climate change, it is predicted that drought conditions may occur more frequently during the growing season. Drought stress would further exacerbate the root disease problem and result in greater yield losses. Cereal root rot problem may also be enhanced by improper choice of crop rotation and/or cropping system. Available documented studies pointed out that these diseases were of economic importance during early 1980s (Baye, 1984, El Yousfi, 1984). Furthermore, root rot diseases are prevalent in arid and semi-arid regions of Morocco, and their symptoms are of different types and are growth stage dependent. They reduce plant stand through a reduced seed germination or seedling blight, therefore, affecting crop establishment. Typical symptoms are brown lesions of the root system and characteristically on the sub-crown internodes. At advanced growth stages, infected field may have reduced biomass and produce whiteheads, consequently, seed quality and grain yield are impaired. Most of the studies done in morocco about cereal root rot diseases were undertaken in conventional agriculture, and with the promotion of conservative agriculture little is known about the behavior of these diseases in this later cropping system. Despite of the importance of these diseases in conservation agriculture, virtually no research has been conducted partly due to lack funding but also because of the complexity of these diseases. Also, because the symptoms are not readily observed on the above ground plant parts, root diseases are often not recognized as the main cause and often confounded with foliar diseases. With is mind and with the lack of current research on cereal root rots, the prudent approach at this time is to begin with a survey to determine the prevalence of these root diseases in fields adopting conservative agriculture, stating from the first cropping season to the end of the project. Additionally; soil health monitoring will be undertaken in different crop rotation to help establish importance and relative frequency of each causal agent of the cereal root rot diseases. I anticipate that this work will have a significant impact on wheat and barley production in the region of the project and the finding may be extended to major cereal regions of Morocco. This will be achieved by providing more information regarding the impact of the crown and root rot diseases on wheat production in our region.

- Identifying and characterizing the fungi associated with the diseases in the two cropping system conservative and conventional agriculture.
- Identifying crop rotation suitable to bring these diseases under control
- Select adapted varieties according to the level of soil health.

Ultimately, the results of this study will mitigate yield losses due to root diseases by the use of effective disease management methods based on our research outputs.

## Procedures

Specific procedures for this project are:

- Survey cereal root rot disease incidence and severity in the cropping system I the region of the project.
  - Update knowledge about root rot and determine the relative importance of root diseases so that we can prioritize future research, when extending the finding to other cereal regions
  - This work will take responsibility for conducting a comprehensive region wide survey of the spring wheat and barley production. Approximately 50 fields will be systematically sampled per two regions and per rotations to ensure coverage of the entire wheat and barley production in regions of the project. From fields sampled, root and crown tissues will be checked for symptoms to determine the incidence and severity of root diseases.
- Identify and characterize the fungal population associated with root diseases. The root and crown tissues obtained during the field surveyed will be brought to the laboratory and be used for isolation of pathogens to confirm causal agents. The isolates obtained will be added to the collection of pathogens for further analysis.
- Selective media will be used to recover pathogens where multiple pathogens may be present. Isolated fungi will initially be identified based on morphological characteristics and the identities confirmed by a genetically following DNA extraction in another lab involved in the project. Inoculations of wheat plants will be conducted in the greenhouse for a test of pathogenicity.
- Severity and disease incidence will be related to yield components of a crop within crop rotation within and among regions of the project.
- Screen commercial wheat and barley cultivars and lines for resistance to common root rot and crown rot. Approximately 32 durum wheat, 22 bread wheat and 27 barley varieties will be screened for root rot pathogens isolated from fields dedicated to conservative agriculture.
- Develop effective methods for screening for resistance against root rot pathogens. This project will also allow us to develop and/or further refine our expertise in working with these pathogenic fungi, especially to conduct inoculated greenhouse experiments.

- Foliar diseases will also be monitored in this project and compare their development with the development of the ones thriving in the fields of conventional system, and based on threshold levels, appropriate control measure will be conducted. In this regard yield losses will be closely monitored based on treated and untreated plots within each rotation and region.
- Data analysis will be based on a hierarchical mixed procedure with repeated measures. Fields will be taken as random and rotation as fixed factors.

Selected references are provided herein as a compilation of the available information stating the level of knowledge and development achieved in root rot disease under Moroccan conditions. This compilation refers to studies dealt with cereals root rot diseases including surveys, etiology, epidemiology, selection for disease resistance, effect of cultural techniques, and biological control.

### Trial 2. Assessment of soil chemical quality on Wheat under no-tillage and various crop rotations system

### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | Z. ABAIL, | 5 |
| | O. IBEN HALIMA, | 5 |
| | M. EL GHAROUS | 5 |
| | O. EL GHARRAS | 2 |
| AGENDA | A. EL BRAHLI | 1 |
| RSSA | A. MAYFIELD | 5 |
| ICARDA | (PTC) | |
| Partners: Farmers | | |
| Input suppliers e.g. importers | | |

### Justification

Good quality soil is critical for crop production sustainability and environmental health and is vital to global function. Research on CA systems all over the world has shown its positive effect on the indicators of soil quality. In semi-arid Morocco, it was found that the soil's attributes have drastically changed due to elimination of soil manipulation with tillage tools. Also, it is well accepted that a rotation or cropping system helps in diversifying crops, maintaining higher yields and improving soil quality.

### Objective

The objective of this study is to examine the effect of various rotation and no-tillage systems on soil quality and wheat production.

#### Trial management

- Variety: Arrihane
- Soil type: The most dominant soil type in the region (to be the same for the three farms)
- Rotations: Wheat- legume, wheat-oil crop, wheat-forage
- Weed control: Glyphosate herbicide to control any standing vegetation prior to planting and in fallow periods
- Disease control: for septoria control if necessary
- Fertilizing: Fertilizers will be used according to soil test for each crop.

**Experimental design**

- Treatments: Two tillage systems (no-tillage and traditional tillage)
- Fields for each tillage treatment will be selected randomly and treated as experimental units. Within each field a 12 m-12 m grid will be established.

**Soil sampling:**

- Soil sampling for analysis: Before cultivation and sowing, take soil samples at the four grid corners within each field from the non-traffic areas between the crop rows at the depths (0–5, 5–10, 10–15 and 15–20 cm). After the samples are air-dried and analyzed for: pH (H2O), organic matter, total N, available P, exchangeable K, cation exchange capacity, (CEC) and electrical conductivity, EC (soil/water ratio, 1:2).
- Soil sampling for water content monitoring: Soil sampling will be done at different stages of the growing period for water content at depth of 0-5 ; 5-10 ; 10-20 ; 20-30 ; 30-45 ; 45-60 ; 60-75 ; 75-90 ; 90-100 cm. Test soil water content of the experimental field using soil sampler and oven-dry method. Soil samples will be taken just before sowing, at tillering, Anthesis and maturity.

**Climatic data**

- Record the local meteorological data such as daily precipitation, temperatures, relative humidity from October till harvest time.

**Statistical analysis of data**

- Data will be subject to analysis of variance and least significant differences (LSDs) to assess significance of differences among treatments.

**Expected results**

- Changes in soil quality attributes (namely ) in relation to tillage system will be detected;
- Effect of crop rotation on soil quality attributes will be determined
- Effect of crop rotation and tillage system on wheat yields

## Trial 3. Assessment of soil physical properties on wheat under no- tillage and various crop rotations system

### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | O. IBEN HALIMA, | 5 |
| | Z. ABAIL, | 5 |
| | M. EL GHAROUS | 5 |
| | O. EL GHARRAS | 2 |
| AGENDA | A. EL BRAHLI | 5 |
| RSSA | A. MAYFIELD | 5 |
| ICARDA | (PTC) | |
| Partners: Farmers | | |
| Input suppliers e.g. importers | | |

### Justification

Soil quality is simply defined as “the capacity of a specific kind of soil to function”. It’s generally assessed by measuring a minimum data set of soil properties to evaluate the soil’s ability to perform basic functions. When measuring soil quality, it's important to evaluate the physical, chemical and biological properties of the soil. Larson and Pierce (1991) developed the concept of "Minimum Data Set" (MDS) which could be to monitor soil quality.

Soil organic matter has long been recognized as a keystone soil quality, estimated from determinations of organic C.SOM or SOC is integrally tied to many soil quality indicators and is arguably the most significant single indicator of soil quality and productivity (Robinson et al., 1994).

Maintenance of soil organic carbon is paramount to sustaining soil quality. Tillage-induced losses of SOC occur rapidly. In Texas, USA researchers found the loss of SOC from a field taken out of native sod production and tilled from 7 yrs equivalent to that from a field cultivated from 70 yrs (Zobeck et al.,1995).

## Objective

It's well accepted that a rotation or cropping system helps in diversifying crops, maintaining higher yields, reducing disease severity and increasing diversity of pools and microbial communities. Also, numerous researchers have demonstrated that conservation tillage is effective in improving soil physical and chemical properties and crop yield.

Fallowing was found obligatory for semi-arid areas if sustainable yields are expected (Bouzza 1990, Mrabet, 2000). Mrabet et al., (2001a) reported increased total and particulate soil organic matter with continuous no-tillage wheat.

The experiment will be conducted to examine the short-time effect of no-tillage and residue management on soil physical properties and wheat production in different crop rotations system.

Trial management for the first year

- Variety: Arrihane or other variety
- Soil type: The most dominant soil type in the region (to be the same for the three farms)
- Rotations: Wheat- Wheat, wheat-forage, wheat-wheat-fallow
- Weed control: Glyphosate herbicide is used to control any standing vegetation prior to planting and in fallow periods
- Disease control: if necessary
- Fertilizing: Fertilizers is used according to soil test for each crop.

Research design and treatments

- Research design: the experiment design will use random incomplete blocks with three replications.
- Treatments: Three rotations: each rotation will be affected to one farm or in the same farm.
  - One tillage systems: no-tillage will be compared to farmer practice
  - Three levels of residue $NT_{50}$=half residue cover, $N_{80}$ and $N_{100}$= full residue cover

Soil Sampling and preparing for analysis

- **Soil sampling for analysis:** Before cultivation and sowing, take soil samples at the four grid corners within each field from the non-traffic areas between the crop rows at the depths (0-2,5, 2,5, 7-20, 20-40 cm). After the samples are air-dried and analyzed for:
  - pH , Texture;
  - Total organic carbon and Nitrogen; particulate organic C and N;
  - Bulk density manually driven into 30cm: the soil core will be split into three sections: 0-10, 10-20, 20-30cm from the soil surface depth.
  - Soil moisture;

- Aggregate stability: Aggregate stability refers to the ability of soil aggregates to resist disintegration when disruptive forces associated with tillage and water or wind erosion are applied Water.
- Cation exchange capacity.

Experiment observations and recording

- Climatic information:
  - This item includes precipitation and high and low average temperatures for each month from seeding date until harvest time.
- Crop data
  - **Crop management data:** including wheat variety, the fertilizer types applied and their nutrient profiles, the time, rate and method of fertilizer application, the sowing time and method, the weeding method and frequency, the harvest time, and other field management measures
  - **Plant density:** record seedling emergence and plant density at jointing and grain filling stages.
  - **Phenological data:** record dates of growth stages of wheat in each plot: seedling stage, tillering stage, jointing stage, booting stage, grain filling stage and mature stage.
  - **Harvest data:** gain yield and total dry matter.

Expected results

- Changes in soil physical quality attributes (namely ) in relation to tillage system will be detected;
- Changes in soil physical quality properties in relation to residue cover will be investigated
- Combined effect of residue management and crop rotation on wheat yield is shown.

#### *2.2.3.3. Tunisia*

### Team in charge

| Scientist name | Institution | Time allocated |
|---|---|---|
| Mohamed Annabi (activity coordinator) | INRAT | 20 |
| Samia Gargouri | INRAT | 10 |
| Nadira Ben Issa | INAT | 20 |
| Hatem Cheick M’hamed | INRAT | 5 |
| Anis Bouselmi | INGC | 20 |

### Background

- Intensification of arable crops in Tunisia (tillage, unreasonably use of chemical inputs, farmers’ reticence to adopting adequate crop rotations…) does not provide sufficient economic growth.
- Soil fertility degradation in northern Tunisia is critique and it is mainly induced by soil organic matter depletion and by water erosion. These concerns can lead to middle and long-term food insecurity and mediocre rural conditions; and a more sustainable land use is urgently requested.
- Conservation agriculture based on no-tillage technique is an important element of the overall Tunisian effort to make agriculture activities compatible with protection and durability of resources. The adoption by smallholder farmers of no-tillage practices is a

key of the successful of this system since they are the largest population of farmer and they have often a degraded small surface.

- Changes in tillage, rotation and residue management may induce major shifts in the soil fertility and composition of soil fauna both pathogenic and beneficial organisms.

## Objectives

The objectives of this activity is the assessment of soil fertility and health and water productivity under conservation agriculture system

## Methodologies

- The study will be conducted in different farmer-pilot sites in the delegation of Fernana (Governorate of Jendouba), about 170 km from Tunis (north-western of Tunisia). Fernana is located in sub-humid zones (mean annual rainfall of 700 mm) with an accentuated land slope and soil losses concerns.
- This activity (2.2.3) will measure variables (about soil quality and health) in the crop rotation experimental sites (activity 2.2.2) and crop residues management (activity 2.3.1). The Experimental Design is a randomized complete block design with farms as blocks (4) and one factor (crop succession treatment for activity 2.2.2 and crop residue management treatment for activity 2.3.1.
- The rotation (activity 2.2.2) will be tested are biennial faba bean/wheat, vetch-triticale/wheat, wheat/wheat; both phases each year; cultivated with best crop management. Plot size is about 2500 m² with trial duration of 4 years. Data Analysis will be done by regression procedure.
- The crop residue management (activity 2.3.1) will be tested under a biennial legume/wheat rotation; each rotation phase is present each year, with best crop management. The plot size is about 1600 m² according to the filed shape with trial duration of 4 years. Wheat residue management options are (i) harvest high, leave straw, no grazing (ii) harvest normal , remove straw, no grazing (iii) harvest normal , remove straw, 50% grazing (iv) harvest normal, remove straw, 100% (normal farmer) grazing (v) Farmer’s field alongside the trial

### Observations and measurements

- Meteorological data
- Crop residue amount (dry matter) crop before sowing and after harvest
- Soil fertility parameters following before crop sowing of the first year: slope, texture, pH, soil organic matter, water infiltration, water stable aggregate
- Soil fertility parameters following after harvest of each crop: soil organic matter (content at different depth, physicochemical quality and dynamics of soil organic matter); water soil erosion appreciation using Le Bissonnais method (ISO/FDIS 10930); Soil compaction and water infiltration (double-ring infiltration method).
- Soil moisture following during crop cycles (under different soil depth with TDR measurement).
- Monitoring soil and residue populations of soil-borne pathogens for different rotations under natural conditions and across years (soil dilution on PDA; qPCR Predicta B test).
- Incidence and severity of soil-borne diseases in wheat plants for the different rotations under natural conditions and across years.

## Inputs needs (year 1)

### Laboratory Chemicals and analysis

| | Cost ($) per sample | Number of samples |
|---|---|---|
| pH, texture | 20 | 32 |
| Residues amount and characterization | 30 | 64 |
| Organic matter content and quality (biodegradability and fractions) | 60 | 32 |
| Water aggregate stability | 30 | 64 |
| Soil compaction | 30 | 64 |
| TDR measurement | 20 | 192 |
| Incidence of soil-borne pathogens in soil and residues (qPCR) | 100 | 64 |
| Incidence and severity of soil-borne diseases in plants | 20 | 60 |
| Total | | |

### Outings (year 1)

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sept | oct | nov | dec | jan | feb | mar | apr | May | Jun | Jul | Aug |
| Farmers choice | $1^a$ | $1^a$ | | | | | | | | | | |
| Initial soil sampling and trial installation | | $5^a5^b$ | | | | | | | | | | |
| Monitoring of soil moisture | | | | $1^a1^b$ | $1^a1^b$ | $1^a1^b$ | $1^a1^b$ | $1^a1^b$ | $1^a1^b$ | | | |
| Soil compaction monitoring | | $3^a3^b$ | | | | | | | | | $3^a3^b$ | |
| Incidence of soil borne-pathogens in wheat | | | | | | | | $4^a$ | | | | |
| Monitoring soil-borne pathogens in soil | | $3^a$ | | | | | | | | | $3^a$ | |
| Final soil sampling | | | | | | | | | | $4^a4^b$ | | |
| Total | $32^a$+ $21^b$ | | | | | | | | | | | |

[a]: Researcher; [b]: Technician

## Budget (year 1)

(see table budget)

## Milestones/timeline achievement

- - Determination of no-tillage effect on soil fertility, water use efficiency, carbon sequestration and plant health as influenced by crop sequence. Compilation and analysis of the results and data, publication of prominent results in peer review journal.
- - Provide valuable no-till research informationanddiffusion of information obtained to farmers to accelerate their update/adoption of profitable conservation agriculture.

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sept | oct | nov | dec | jan | feb | mar | Apr | May | Jun | jul | Aug |
| Farmers choice | | | | | | | | | | | | |
| Initial soil sampling /characterization | | | | | | | | | | | | |
| Monitoring of soil moisture/weather | | | | | | | | | | | | |
| Soil compaction monitoring | | | | | | | | | | | | |
| Monitoring soil-borne pathogens in the soil | | Yr2 | | | | | | | | | | →yr 2 |
| Incidence and severity of soil-borne diseases in wheat | | | | | | | | | | | | |
| Final soil sampling/ characterization | Yr2 | Yr2 | | | | | | | | | | →yr 2 |

## 2.3. Sub-objective 2.3. Optimize crop residue management and livestock feeding under CA systems.

### 2.3.1. Activity 2.3.1. Technical and economic assessment of trade-off between surface cover and animal productivity

#### *2.3.1.1. Algeria*

**Team in charge**

| Scientist name | Time allocated |
|---|---|
| Soukhal Djamel | 10 % |
| Brouri Lakhdar | 10 % |
| Abbas Khaled | 10 % |
| Laouar Abdelmalek | 10 % |
| Fortas Bilal | 5 % |
| Bendada Hocine | 5 % |
| Makhlouf Mahfoud | 5 % |
| Koussa Abderrezak | 5 % |
| Belguendouz Abdelghani | 10% |
| Hafsi Miloud | 10 % |

**Justification**

The too accentuated taking of cereal stubble by animals (surcharge in parcels in response to tillage fallow and lack of forage) leads to soil infertility, in particular poverty in organic matter. The return of a minimum residue (stubble) by reducing surcharge and duration of animal grazing on stubble is necessary to restore soil fertility

**Objective**

Achieve a favourable compromise between animal surcharge and surface residue through the results of technical tests and economic evaluation.

## Methodology

Tests pasture with different levels of residue retention conducted with livestock at 5 farmers and economic evaluation.

**Theme of trial: Effect of animal surcharge on stubble in relation to vegetal cover , animal performance and soil properties.**

### Purpose of the test

The goal is to find the optimal animal surcharge for minimum restitution of soil organic matter and seeding the next crop on an adequately soil covered. This allows to:

- Highlight the effects of grazing on soil degradation and constraints success of direct seeding;
- Determine the threshold allowing rational grazing (grazing duration and optimal number of animals), which provides a balance between forage feeding source and degree of soil structure deterioration
- Evaluate number of the financial and economic impact of the reduction in herd livestock.
- Tests pasture with different levels of residue retention conducted with livestock at farmers and economic evaluation.

It will test three animal surcharges: normal, half of normal grazing duration and no grazing on evolution of stubble biomass, their phenological composition and the evolution of animal body condition (weight of the sheep).

They will be taken at the usual pasture cycle which begins in the summer, in farms located in different climatic zones and with different stubble.

Animals surcharges are determined on the basis calculation of daily average of animal collection to achieving three situations:

- Situation of an absolute minimum of residues at the end of the normal grazing duration;
- Situation of an average amount of residues at the end of the grazing period (50%);
- Situation of residues at the end of no grazing case

### Experimental Protocol

Treatments

- T1: Harvest high, leave straw, no grazing
- T2:Harvest normal, remove straw, no grazing
- T3: Harvest normal, remove straw, 50% grazing (half of normal grazing duration)
- T4:Harvest normal, remove straw, normal farmer grazing
- T5 – not really a treatment, but it is also important to take all of the same data from a plot of the farmer's field alongside the trial at each site. This will give information on true farmer practices.

Notes:

- There should be the same number of sheep (ewes) of the same age;
- The use of wire separation between the plots;
- Respect the normal duration of grazing 8 hours per day and 10 days per treatment;
- Evaluation of the weight of the animals at the end of each treatment;
- Conduct the harvest on the same cutting height (Observe the height of cut straw).

Sites implementation

**5 sites**: Khebaba: 2ha, Serssour: 2ha, Boukari: 2ha, Sagrodev: 2ha, Azzoug: 2ha.

Experimental plan

| | | | |
|---|---|---|---|
| Wheat | Wheat | Wheat | Wheat |
| T1 | T2 | T3 | T4 |
| **0,25 ha** | | | **25m** **100m** |
| Lentil | Lentil | Lentil | Lentil |
| T1 | T2 | T3 | T4 |
| | | | |

**Measures and data**

- Soil data (slope, pH, N, SOC, water infiltration , water stable aggregate at every cereal phase
- Soil moisture at seeding, early and late grazing pasture;
- Crops establishment
- Grain and straw yield
- Crop residue before and after grazing
- % ground cover before grazing, after grazing and before sowing legume crop
- Straw removed (kg/ha)
- Nutritive value of removed straw and standing stubble
- Harvest losses (to be discussed and defined)
- Animal growth (optional) economic analysis Soil moisture and erosion (if possible)
- Economic analysis

**Notations on crop phenology**

- Date of start and end of grazing;
- Hour of start and end of grazing.
- Initial weight and final weight of animals before and after grazing (kg).

**Notations on Crop**

- Height of the stubble after harvest;
- Height of the stubble remaining after grazing.
- Solids content of the straw;

- Enumeration paw prints per unit area (03 samples of 1 m2 per treatment);
- Residue coverage rate at seeding in early and late grazing pasture;

## Milestones

- - Results of five residue trials with different levels of covert and grazing to define optimum grazing duration of wheat and lentil stubble

## Inputs mobilization

Wheat plot (5 ha)

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed R1 | 5 ha x 1,4 q=7 q |
| Basic fertilizer TSP (1q /ha) | 5 ha x 1q =5 q |
| Fertilizer coverage (Urea 1q/ha) | 5 ha x 1 q = 5 q |
| Glyphosate (3.5 liter / ha) | 5 ha x 3,5 l = 17,5 l |
| Post emergence herbicide(Pallas OD 0.5 liter / ha) | 5 ha x 1 l = 5 l |
| Fungicide (Artea 0.5 liter/ha) | 5 ha x 0,5 =2,5 l |
| Supplemental irrigation | 5 ha |
| Seeding | 5 ha x 1,4 q=7 |
| Chemical treatment | 2 KG |
| Bag for production (seeds of next campaign) | 140 bags |
| Transport seed 10 ha | 70 q |
| Triage seed | 70 q |
| Treatment seed harvested(Dividend dose 200 ml/q) | 200 ml x 70 q =14 l |
| Treatment seed harvested (operation) | 70 q |
| Wire fence for 5 ha | 5 ha |

Plot lentil (5 ha)

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed | 5 ha x 1q =5 q |
| Basic fertilizer TSP (1q/ha) | 5 ha x 1q =5 q |
| Glyphosate (3.5 liter / ha) | 5 ha x 3,5 l = 17,5 l |
| Post emergence herbicide(Gésagard) | 5 ha x 3,5 l = 17,5 l |
| Post emergence herbicide(Fusillade) | 5 ha x 0,75 l = 3,75 l |
| Fungicide (Artea 0.5 liter/ha) | 5 ha x 2 l = 10 l |
| Supplemental irrigation | |
| Seeding | 5 ha x 1q = 5 ha |
| Chemical treatment | 1 KG |
| Bag for production (seeds of next campaign) | 140 bags |
| Transport seed 10 ha | 70 q |
| Triage seed | 70 q |
| Treatment seed harvested(Divident dose 200 ml/q) | 200 ml x 70 q =14 l |
| Treatment seed harvested (operation) | 70 q |

## Budget

(see table budget)

### Planning

| | Sept | Oct. | Nov. | Dec. | Jan. | Feb. | March | April | May | June | July | Aug. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Farmers choice | x | x | | | | | | | | | | |
| Trial seeding | | | x | | | | | | | | | |
| Monitoring of pesticides and herbicides application | | | | x | x | x | x | x | x | | | |
| Harvesting | | | | | | | | | | x | x | |
| Stubble sampling | | | | | | | | | | x | x | x |

#### *2.3.1.2. Morocco*

### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA: | M. EL KOUDRIM<br>B. EL AMIRI<br>O. IBENHALIMA | 15<br>5<br>5 |
| FST Settat: | Student to be identified | 40 |
| RSSA: | J. FORTUNE | |
| ICARDA | NAFZAOUI | |
| Algeria: | | |
| Tunisia: | S. ABIDI | |
| Partners: Farmers | M. BELHAMRA<br>M. BENDAOUI<br>H. DAOUI<br>C. BERRICHI | |
| Input suppliers/service providers, manufacturers | | |

### Justification:

The accumulation of mulch on undisturbed soil brings protection and food to an intense life of soil that gives the ground a stable structure and still enough macro pores facilitating water infiltration. The coverage rate recommended by several studies is 33%, one third of the crop residue. In the study area, an evaluation of the tailings in absence of stubble grazing residues recovery rate are about 60%. This coverage rate, strong for the biological activity of the soil, however posed problems in no tillage operation. In fact, the accumulation of residues at the level of the 'elements' of seed drill to disrupt the advance of it on the one hand, and to assigned plants thrown in the places of accumulation of residues.

The objective of this part of work is thus to find compromise between the need for ground cover for the success of direct seeding and proper conditions for a good work at the field level, while preserving a very important resource calendar feed to drilling the area level; the thatch.

### Objectives

The objective of this part of work is thus to find compromise between the need for ground cover for the success of direct seeding and proper conditions for a good work at the field level, while preserving a very important resource calendar feed to drilling the area level; the thatch.

## Method

- Experimental Design: Randomized Complete Block Design with farms as blocks (4) and one factor (Crop residue management treatment). (NB: Moroccan team will do 4 blocks on-station and 4 blocks with reduced treatments number on farm)
- Data Analysis by regression
- Trial duration : 4 years
- Rotation : biennial legume/wheat; both phases each year
- Plot size : ≥ 0.25 ha

## Treatments

- Harvest high, leave straw, no grazing
- Harvest normal, remove straw, no grazing *
- Harvest normal, remove straw, 50% grazing (half of normal grazing duration )
- Harvest normal, remove straw, normal farmer grazing*
- Control treatment : famer managed field*

NB. Treatments 1 to four with optimal crop management (seeding rate, fertilizer, weed, pests and disease control etc.

* Retained treatments for on-farm Moroccan trials

## Data :

- Soil data (slope, pH, N, SOC, water infiltration , water stable aggregate at every cereal phase
- Meteorological data
- Crops establishment
- Grain and straw yield
- Crop residue before and after grazing
- % ground cover before grazing, after grazing and before sowing legume crop
- Straw removed (kg/ha)
- Nutritive value of removed straw and standing stubble
- Harvest losses(to be discussed and defined)
- Animal growth (optional)
- Economic analysis
- Soil moisture and erosion (if possible).

### Milestones

| Activities | Completion dates | Persons in charge |
|---|---|---|
| Install trials | October 2012 | Integrated crops-livestock team |
| Collect crop data | Oct-Nov-Dec 2012<br>Jan-Fev-Mars-Avril-Mai 2013 | Integrated crops-livestock team |
| Collect residues data | Jun-July- August 2013 | Integrated crops-livestock team |
| Debug and analyse and interpret crop data | Jun-2013 | Integrated crops-livestock team |
| Debug and analyse and interpret animal data | Sept - 2013 | Integrated crops-livestock team |
| Develop report on residues | Sept 2013 | Integrated crops-livestock team |
| Economic evaluation | Sept 2012 | Socio-economic team |

**Budget:** Travel support (cars, fuel, per diem) site visits – additional to main survey

#### *2.3.1.3. Tunisia*

### Team in charge

| Scientist name | Institution | Time allocated |
|---|---|---|
| Sourour Abidi (activity coordinator) | INRAT | 20 |
| Salah Ben Youssef | INRAT | 10 |
| Bassem MOUALHI | INGC | 10 |
| Hichem Ben Salem | INRAT | 1.5 |
| Hatem Ben Cheikh Ahmed | INRAT | 5 |
| Mohamed Annebi | INRAT | 5 |

### Background

Small ruminants are an important component of mixed crop/livestock systems in Tunisia. Grazing on cereal stubble represents one of the most widespread feeding practices during the summer season in wheat producing regions. However, cereal stubble is characterized by a low nutritive value making it unsuitable to meet nutrient requirements of ruminant animals. Moreover, this traditional practice could negatively affect soil physical properties and crop performance, due to the additive effects of reduced soil cover and animal trampling due to high livestock grazing intensity. Thus, rational grazing management and use of no-till system could prevent soil physical properties to be affected beyond critical thresholds through maintaining enough crop residues, a prerequisite for CA conversion.

### Objectives

Study the effect of some wheat crop residue management treatment on land cover, animal performances and soil fertility under conservation agriculture system.

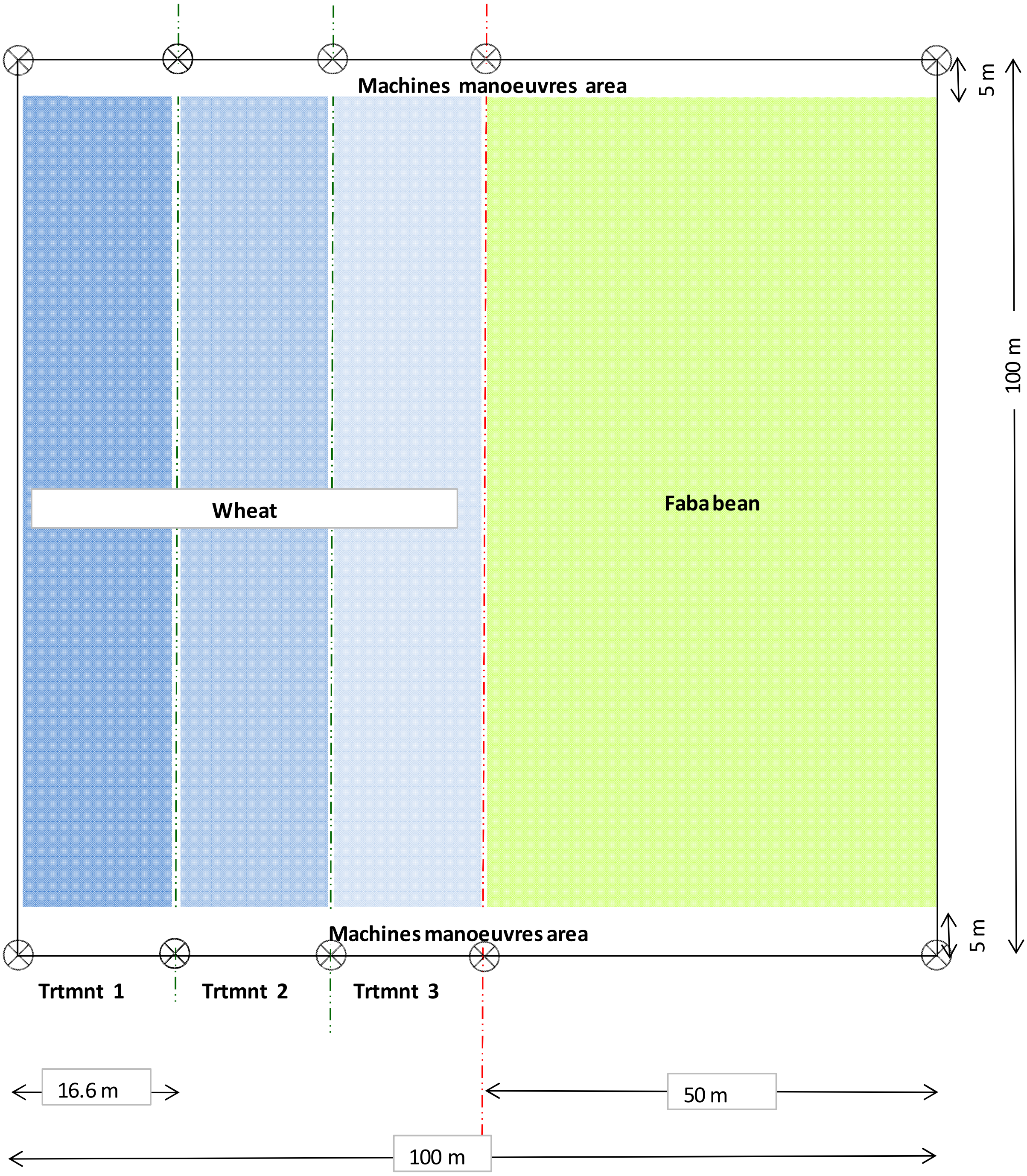
### Methodologies

- Site/locations Fernana, governorate of Jendouba (northwestern of Tunisia).
- Experimental Design : Randomized Complete Block Design with farms as blocks (4) and one factor (Crop residue management treatment). (Figure 1).

- Data Analysis by regression
- Trial duration : 4 years
- Rotation : biennial legume/wheat; both phases each year
- Plot size : (16.6 x 100) m²
- Wheat residue management options :
    - T1**:** Harvest high, leave straw, no grazing
    - T2:Harvest normal, remove straw, no grazing
    - T3: Harvest normal, remove straw, 50% grazing (half of normal grazing duration)
    - T4:Harvest normal, remove straw, normal farmer grazing
    - T5 –farmer's field alongside the trial at each site.
- Rotation imposed: biennial Faba bean-Wheat rotation, each rotation phase is present each year , with best crop management.

### Observations and measurements

- Soil data (slope, pH, N, SOC, water infiltration , water stable aggregate at every cereal phase
- Meteorological data
- Crops establishment
- Grain and straw yield
- Crop residue before and after grazing
- % ground cover before grazing, after grazing and before sowing legume crop
- Straw removed (kg/ha)
- Nutritive value of removed straw and standing stubble
- Harvest losses (to be discussed and defined)
- Animal growth (optional)
- Economic analysis
- Soil moisture and erosion (if possible).




**Trtmnt 1** : harvest high, remove straw , 0 grazing;

**Trtmnt 2** : harvest normal, remove straw, 50% grazing

**Trtmnt 3**: harvest normal, remove straw, full grazing

*NB: crop residue plots are to be fenced at convenient time*

**Fig. 3. Experimental design of the crop residue management trial (at one farm = one block).**

NB: Plots dimensions can change according to the filed shape, but their area remains the same.

## Inputs needs (year 1)

### Supplies

| Needs (units) | area cultivated (ha) | Quantity needed (units) |
|---|---|---|
| seeds | | |
| faba bean (variety badiaa) | 2 | 200 kg |
| Wheat (var Nasr) | 2 | 300 kg |
| Pesticides | | |
| Round up (Glyphosate) | 4 | 12 l |
| Amilcar (g) | 2 | 660 g |
| Stampaqua | 2 | 6 l |
| Basagran (l) | 2 | 4 l |
| Select super | 2 | 2 l |
| Opus | 2 | 2 l |
| Banko (chlorothalonil) | 2 | 4 kg |
| Amistar | 2 | 2 l |
| Decis (deltamethrine) | 2 | 1 l |
| Fertilizers | | |
| Nitrogen (ammonium nitrate) | 2 | 800 kg |
| Di-ammonium Phosphate | 2 | 300 kg |
| Phosphate (super 45) | 2 | 300kg |
| Fence (12 plots) | 500 linear m /block | 2000 linear m |

### Laboratory Chemicals and analysis

| | Cost ($) per sample | Number of samples |
|---|---|---|
| Chemical analysis | | |
| Dry matter, Organic matter | 5 | 150 |
| Crude protein | 15 | 150 |
| Fibre (NDF, ADF, ADL) | 20 | 150 |
| Fibre bags | 5 | 300 |

### Outings (year 1)

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sept | oct | nov | dec | jan | feb | mar | apr | May | June | jul | Aug |
| Farmers choice | 1 [a] | 1 [a] | | | | | | | | | | |
| Trial tracing and staking | | 4 [a] | | | | | | | | | | |
| Trial seeding | | | 4 [a] | | | | | | | | | |
| Monitoring of pesticides and herbicides application | | | | 2 [a] | 2 [a] | 2 [a] | 2 [a] | 2 [a] | 2 [a] | | | |
| Harvesting | | | | | | | | | | 2 [a] | | |

| | | | | | |
|---|---|---|---|---|---|
| Plots fencing | | | 2 [a] | 2 [a] | 2 [a] |
| Stubble sampling | | | 4 [a]<br>4 [b] | 4 [a]<br>4 [b] | 4 [a]<br>4 [b] |
| Total | 42[a]+ 12[b] | | | | |

[a:] Researcher; [b]: Technician

**Budget** (year 1)

(see table budget)

### Milestones/timeline achievement

- Determination of convenient grazing duration of wheat and faba stubble. Publication of prominent results in peer review journal.
- Diffusion of information obtained to farmers to accelerate their adoption of profitable conservation agriculture.

## 2.3.2. Activity 2.3.2. Develop and test alternative integrated feeding options (forage crops, alley-cropping, by-products)

### *2.3.2.1. Algeria*

### Team in charge

| Scientist name | Time allocated |
|---|---|
| Soukhal Djamel | 10% |
| Brouri Lakhdar | 10 % |
| Abbas Khaled | 10 % |
| Laouar Abdelmalek | 10 % |
| Fortas Bilal | 5 % |
| Bendada Hocine | 5 % |
| Makhlouf Mahfoud | 5 % |
| Koussa Abderrezak | 5 % |
| Belguendouz Abdelghani | 5 % |

### Justification

The return of a minimum residue (stubble) recommends lowering the overhead and duration of animal grazing on stubble, a decrease of food supply. That stubble grazing is an essential practice of farming systems, it is difficult to replace by feeding sheepfold.Therefore it is necessary to increase summer grazing resources and manage them properly.

Furthermore, resorption of fallow by forage crops or its transformation into a multi-year grazing improves food stocks and gives operators more flexibility in the management of the sheep flock.

Thus it would be possible envisage the change of the reproductive system of sheep to shift in time of gestation and parturition.

This reduces the demand for food summer and therefore a better return organic matter to the soil grain stubble.

## Objective

Development and testing of alternative integrated feed options and low cost (forage, forage associations, temporary meadows, forage legumes ...) to improve the quantity and quality of food supply farms and thus help them to adapt the livestock management in CA.

This action aims to replace the fallow by alternatives forage. It will test the behavior of forage and productivity for different bioclimatic zones (South, Central and North) under rainfed conditions.

## Methodology

Behavior of forages tested in different production zones in five farmers.

**Theme: Behaviour and forage productivity of some associations (pea-triticale, barley- peas, alley-cropping) introduced to replace fallow**

Sites implementation

5 sites = 10.8 ha(Khebaba 2.16ha, Serssour 2.16ha,Azzoug 2.16 ha, Sagrodev 2.16 ha)

Experimental design

Randomized Complete split plots Design with farms as blocks (3 to 4) and two factors (Alley cropping as main factor, and forage options as sub plots).

**Forage crop**: barley-Peas / Peas-Triticale.

**Alley cropping**: Atriplex (10 m between rows)

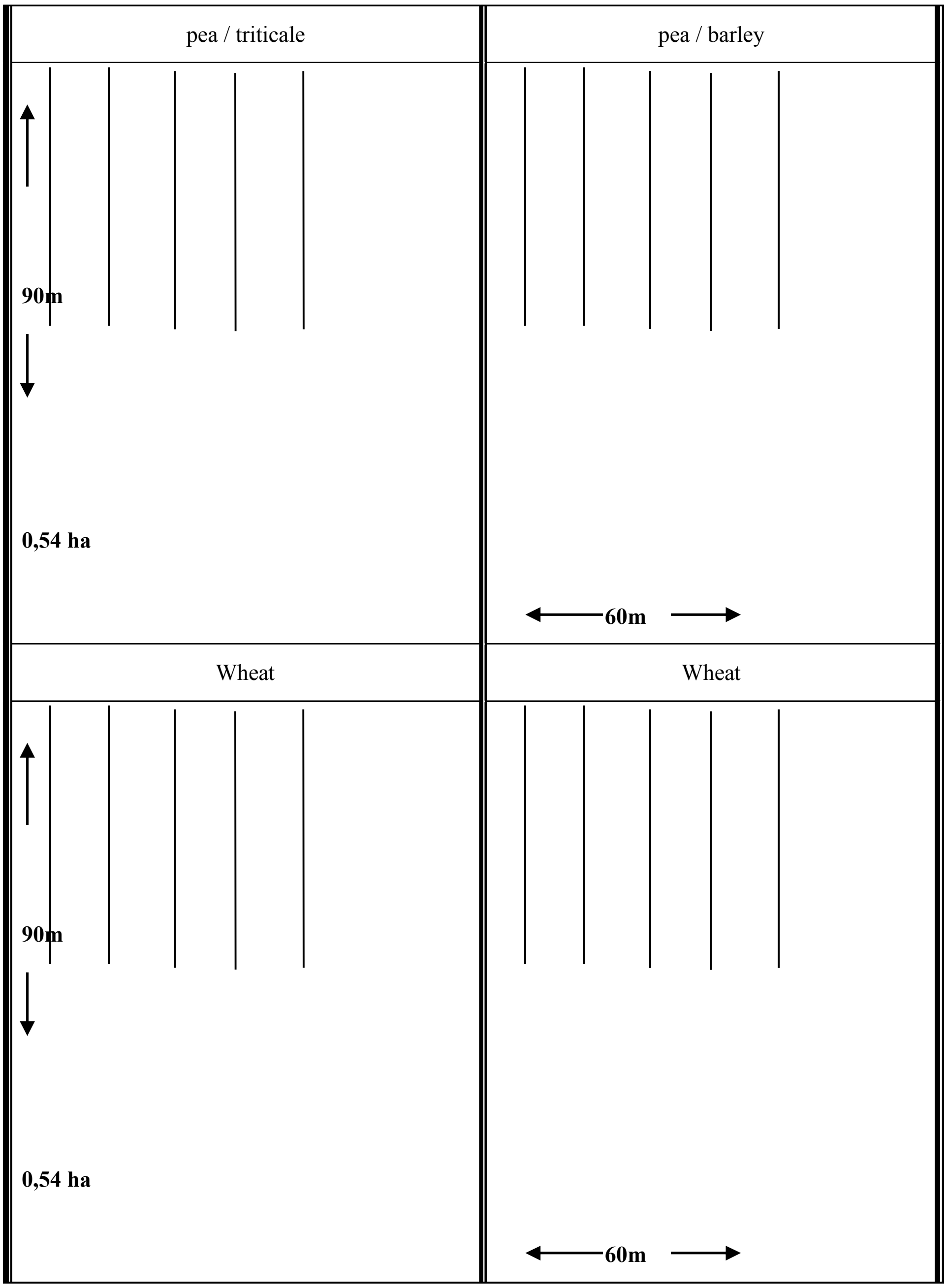
Cereal crop: wheat

NB: Respect doses seed associations:

- Peas: 1 q/ha and barley: 0.40 q/ha;
- Peas: 1 q/ha and triticale: 0.40 q/ha;

Respect period of mowing associations.

## Experimental plan




## Measurements

### Notations on phenology

- Different dates of phenological stages of cereals and legumes;
- Dates of matching associations

### State of the field before planting

- Condition of residues (types, coverage ground in %);
- Previous crop;
- Weed problemof theprevious crop(with photos).

**Conduct of the test**

- Species, Variety;
- Thousand grain weight;
- Germination in%;
- Sowing date;
- Dose seed (kg / ha) in the laboratory;
- Fertilization background (date / stage, type, dose);
- Nitrogen first contribution (date / stage, type, dose);
- Nitrogen second contribution (date / stage, type, dose);
- Total weeding (date / stage, type, dose);
- Weeding post emergence (date / stage, type, dose);
- Diseases chemical treatment (date, type, dose);

**Weeds**

- Identification of weeds at the onset of each phenological stage of the crop in the seed row and the rest of the plot (with photos taken);
- Level of infestation broadleaf each phenological stage of the crop using the rating scale Baralis;
- Level of infestation grass each phenological stage of the crop using the rating scale Baralis;
- Density of weeds/m² (grass and broadleaf) to the end of winter, at elongation stage and heading stage by the most important species on five plots of 1m ².

**Crops**

- Number of emerged plants / m² plots at homogeneous
- Evaluation of the emergence rate (%);
- Observation on seedling vigor;
- Depth of sowing;
- Dry matter at anthesis / m²;
- Densities of weeds (grass and broadleaf);
- Components of yield and yield (grain) of cereals;
- Forage yields at key stages and nutritive value at each harvest
- Rate of grain harvest (%).
- Yield straw;
- Dry matter: part of the grain and part of the legume.
- Economic evaluation (cost of realization of the various farming operations)

## Milestones

- Practical guide and paper published on alternative food resources, covering adapted forage species.

## Inputs needed

### Wheat crop: (5.4 ha)

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Seed R1 | 5,4 ha x 1,4q=7,56 q |
| Basic fertilizer TSP (1q/ha) | 5.4 ha x 1q =5,4 q |
| Fertilizer coverage (Urea1q/ha) | 5,4 ha x 2 q = 10,8 q |
| Glyphosate (3.5 liter / ha) | 5,4 ha x 3.5l = 18,9 l |
| Post emergence herbicide(Pallas OD0.5 liter / ha) | 5,4 ha x 1l = 5,4 l |
| Fungicide (Artea 0.5 liter/ha) | 5,4 ha x 0.5 =2,7 l |
| Seeding | 5,4 ha x 1,4 q=7,56 q |
| Chemical treatment | 5.4 ha |
| Bag for production (seeds of next campaign) | 140 bags |
| Transport seed 10 ha | 70 q |
| Triage seed | 70 q |
| Treatment seed harvested(Divident dose 200 ml/q) | 200 ml x 70 q =14 l |
| Treatment seed harvested (operation) | 70 q |

### Pea (5.4 ha), Barley (2.7 ha), Triticale (2.7 ha)

| Inputs | Quantity |
|---|---|
| Lime (tracing) | 60 kg |
| Pea seed | 5.4 ha x 1q = 5.4 q |
| Barley seed | 2.7 ha x 0,4q=1.08 q |
| Triticale seed | 2.7 ha x 0,4q= 1.08 q |
| Basic fertilizer TSP (1q/ha) | 5.4 ha x 1q = 5.4 q |
| Glyphosate (3.5 liter / ha) | 5.4 ha x 3.5l = 18.9 l |
| Fungicide (Artea 0.5 liter/ha) | 5.4 ha x 0.5 =2.7 l |
| Seeding operation | 7,56 ha |
| Chemical treatment | 5.4 ha |
| Bag for production (seeds of next campaign) | 140 bags |
| Transport seed 10 ha | 70 q |
| Triage seed | 70 q |
| Treatment seed harvested(Divident dose 200 ml/q) | 200 ml x 70 q =14 l |
| Treatment seed harvested (operation) | 70 q |

## Budget

(See table budget)

### Planning

| | Sept | Oct. | Nov. | Dec | Jan | Feb | March | April | May | June | July | Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Farmers choice | x | x | | | | | | | | | | |
| Trial seeding | | | x | | | | | | | | | |
| Monitoring of pesticides and herbicides application | | | | x | x | x | x | x | x | | | |
| Atriplex plantation and maintenance | | | | | | | | | | | | |
| Sampling | | | | | | | x | x | x | | | |
| Harvesting | | | | | | | | | x | x | x | |

### *2.3.2.2. Morocco*

### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA: | M. EL KOUDRIM | 15 |
| | B. EL AMIRI | 5 |
| FST Settat: | Student to be identified | 40 |
| RSSA: | A. MAYFIELD | |
| ICARDA | NAFZAOUI | |
| AGENDA: | A. EL BARHLI | 5 |
| Tunisia: | S. ABIDI | |
| Partners: Farmers | H. DAOUI | |
| Input suppliers/service providers, manufacturers | | |

### Justification

The practice of leguminous forage crops in rain fed condition for animal feed in the area is very limited. The introduction of legumes in current operating systems will contribute to the improvement of existing systems by: (1) the improvement of fertility and soil conservation, (2) improvement of the rotation, (3) improving production and quality of fodder and (4) the reduction in purchases of feed. The food deficit can be filled with hay and silage production. Legumes that will be tested will have their place in the feed mixtures with cereals such as barley, oats or triticale; or in pure culture for the production of quality hay.

### Objectives

- Introduce varieties of forage legumes.
- Apply a conduct adapted to the environmental conditions;
- Involving farmers in the choice of adapted species/varieties and the form on driving methods, harvesting and use.

## Methodology

Experimental Design: Randomized Complete Bloc Design.

Trial duration: 4 years

Alley cropping: (10 m between rows)

Rotation: biennial forage/cereal rotation; both phases each year.

Treatments:

1. No alley cropping: as check
2. Atriplex as alley cropping
    a. Phase 1:
        i. Forage peas and barley mixture
        ii. Forage peas and triticale mixture
    b. Phase 2: Barley and triticale

## Data

- Site characterization (soil fertility, slope, etc.)
- Meteorological data
- Plant stands
- Weed populations
- Forage yields at key stages and nutritive value at each harvest
- Grain yield of cereals
- Economic evaluation

## Milestones

| Milestones | Completion dates | Persons in charge |
|---|---|---|
| Install trials | October 2012 | Integrated crops-livestock team |
| Collect crop data | Oct-Nov-Dec 2012<br>Jan-Feb-Mars-Avril-Mai 2013 | Integrated crops-livestock team |
| Collect animal data | Jun-July- August 2013 | Integrated crops-livestock team |
| Debug and analyze and interpret crop data | Jun-2013 | Integrated crops-livestock team |
| Debug and analyze and interpret animal data | Sept l2013 | Integrated crops-livestock team |
| Develop report on crop and livestock integration | Sept 2013 | Integrated crops-livestock team |
| Economic evaluation | Sept 2012 | Socio-economic team |

## Budget

Travel support (cars, fuel, per diem) site visits

### *2.3.2.3. Tunisia*

#### Team in charge

| Scientist name | Institution | Time allocated |
|---|---|---|
| Salah Ben Youssef (*activity coordinator*) | INRAT | 10 |
| Sourour Abidi | INRAT | 20 |
| Bassem MOUALHI | INGC | 10 |
| Hichem Ben Salem | INRAT | 1.5 |

#### Background

Domestic agricultural production is insufficient and faces a number of severe constraints which the most important is the limited natural resources and the lack of forage crop diversification. Thus, farmers should monitor the performance of sheep throughout summer and autumn to provide feeding strategies that will prevent unwanted losses of bodyweight. On other hand, not all stubbles are of the same quality: different varieties and growing conditions can produce it of widely varying nutritional value. Livestock nutrition and productivity could be increased with new forage or dual-purpose varieties, and greater use of alternative feed sources such as cactus and other adapted shrubs.

#### Objectives

- Develop and test different convenient forage options as alternatives to wheat stubble and straw for ruminants.
- Study the potential use of alley cropping system using cactus as alternatives feed resource to animals.

#### Methodologies

**Experimental Design**

Randomized Complete split plots Design with farms as blocks (3) and two factors (Alley cropping as main factor, and forage options as sub-plots). (figure 1).

**Treatments**

- **Alley cropping**: Alley cropping vs. no alley cropping
- **Forage option**: Winter triticale-hairy vetch mixture vs. rainfed alfalfa (other mixture will be tested next years)
  - Trial duration: 4 years
  - Alley cropping (Cactus inermis): (10 m between rows, plant spacing: 1 m)
  - Rotation: biennial forage/cereal rotation; both phases each year.
  - Plot size :
- Main Plots: 80m x 45m = 0.36 ha
- Sub Plots : 10m x 20m = 200 m².

**Observations and measurements**

- Site characterization (soil fertility, slope, etc.)
- Meteorological data
- Plant stands
- Weed populations
- Forage yields at key stages and nutritive value at each harvest

- Grain yield of cereals
- Economic evaluation

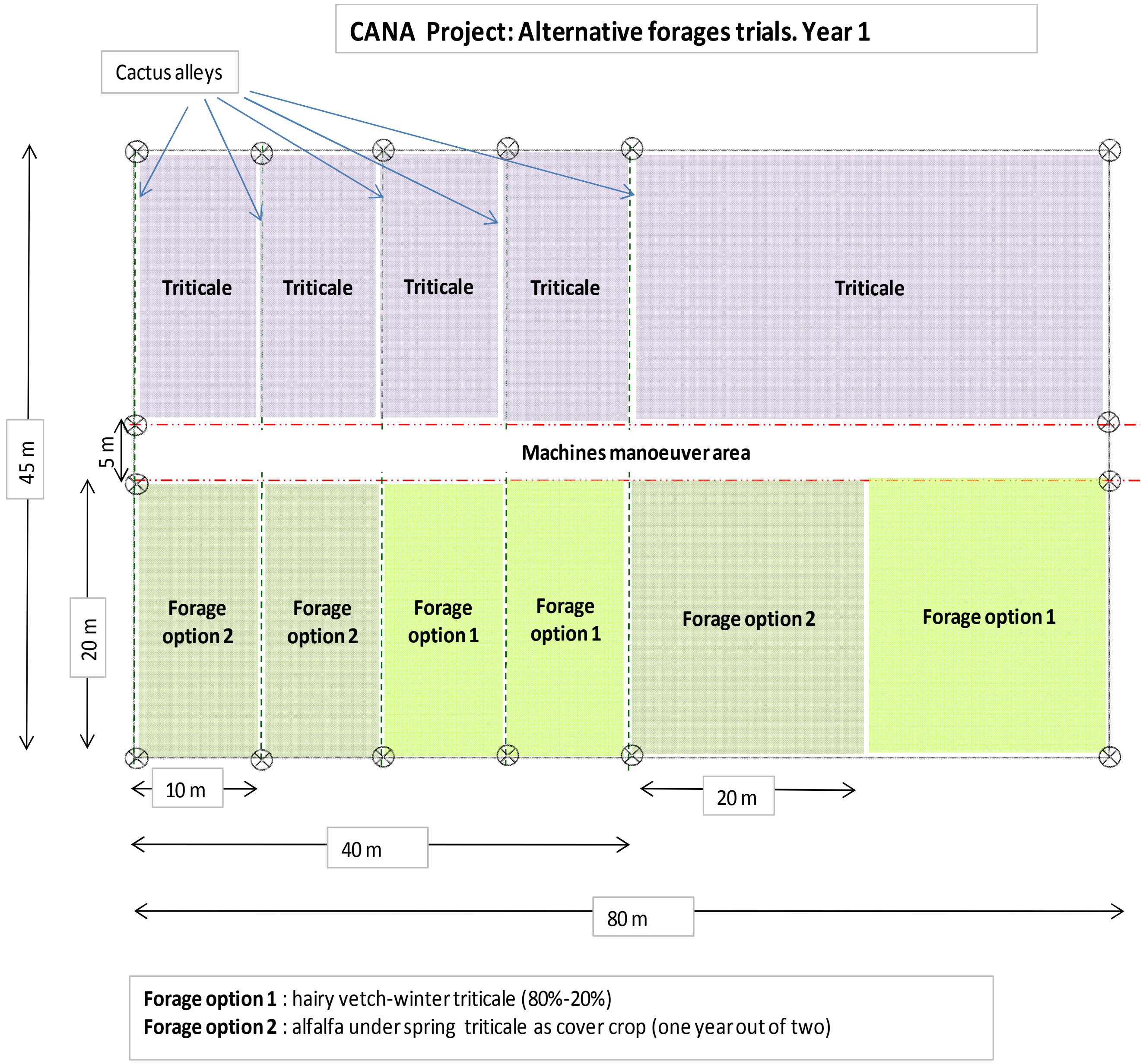



**Fig. 5. Experimental design of the alternative forage trial (at one farm = one block).**

## Inputs needs (year 1)

### Supplies

| Needs (units) | Area cultivated (ha) | Quantity needed (units) |
|---|---|---|
| seeds | | |
| Triticale commercial cultivar) | 0,96 | 144kg |
| Forage option 1 | | |
| rainfed alfalfa | 0,24 | 4,8kg |
| Forage option 2 | | |
| Winter triticale | 0,24 | 7,2kg |

| | | |
|---|---|---|
| Hairy vetch | 0,24 | 12kg |
| Pesticides | | |
| Glyphosate (l) | 1 | 3 l |
| Amilcar (g) | 1 | 330 g |
| basagran (l) | 0,24 | 0,48 |
| Doppler (l) | 0,24 | 0,48 |
| Select super (l) | 0,24 | 0,24 |
| Fertilizers | | |
| spring triticale (commercial cultivar) | | |
| Nitrogen (ammonium nitrate) | 1 | 300 kg |
| Di-ammonium Phosphate | 1 | 200 kg |
| Forage option 1 | | |
| Nitrogen (ammonium nitrate) | 0,24 | 25 kg |
| Phosphate (super 45) | 0,24 | 50 kg |
| Forage option 2 | | |
| Super 45 | 0,24 | 50 kg |
| Alleys | | |
| Cactus pads | 1000 linear m | 1000 |
| Nitrogen (ammonium nitrate) | 1 | 300 |
| Total | | |

## Laboratory chemicals and analysis

| | Cost ($) per sample | Number of samples |
|---|---|---|
| Chemical analysis | | |
| Dry matter, Organic matter | 5 | 220 |
| Crude protein | 15 | 220 |
| Fibre (NDF, ADF, ADL) | 20 | 220 |
| Fibre bags | 5 | 440 |

## Outings (year 1)

| | Months | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | sept | oct | nov | dec | jan | feb | mar | apr | May | June | jul | Aug |
| Farmers choice | 1 | 1 | | | | | | | | | | |
| Trial tracing and staking | | 4 | | | | | | | | | | |
| Trial seeding | | | 4 | | | | | | | | | |
| Monitoring of pesticides and herbicides application | | | | 2 | 2 | 2 | 2 | 2 | 2 | | | |
| Cactus plantation and maintenance | | | | | | | | 6 | 2 | 2 | 2 | 2 |
| Sampling | | | | | | | 2 | 2 | 2 | 2 | 2 | 2 |
| Total | 42[a]+ 12[b] | | | | | | | | | | | |

[a]: Researcher; [b]: Technician

## Budget (year 1)

(see table budget)

**Milestones/timeline achievement**

- Determination of convenient grazing duration, nutritive crops and alternative feeding options (alley cropping). Publication of prominent results in peer review journal.
- Diffusion of information obtained to farmers to accelerate their adoption of profitable conservation agriculture.

# 3. Objective 3. To enhance the capacity of NARES staff and other stakeholders to practice and promote CA

*Operational coordinator: Dr. Mohammed El Mourid (ICARDA)*

## 3.1. Activity 3.1. Raise awareness on CA system potential benefits and shortcomings among farmers, private sector including manufacturers, NGOs, and decision-makers

### 3.1.1. Algeria

**Justification**

Production and dissemination of sufficient knowledge about innovation in production methods with CA systems, profits and income potential on solutions tailored to environmental and agricultural objectives through direct contact with farmers and private sector including industry, NGOs, and policy makers to create a better space for negotiation and better defend the cause of the CA.

**Objective**

Extend knowledge of CA in country across all actors involved in the development of AC using all means of communication.

**Materials and methods**

- Three workshops with the participation of all partners involved supplemented with field visits:
  - At the start of the project for presentation and discussion of the project activity program with all stakeholders involved in the development of CA, with thematic presentation of the CA;
  - During the mid-growing season completed with field visit to expose the activities;
  - At the end of the season with field visits at the end of the season to present results and plan future activities.
- Different exposure is programmed in each workshop (posters, exhibition equipment and distribution of brochures and documents).

| Workshop | Target group and participants | Responsibility |
|---|---|---|
| Inception Workshop (Period mid-October)<br>2nd workshop during the mid-growing season with a visit to the field<br>(Period late March and early April) | Farmers, Farmer Organizations, NGOs, Manufacturers, institutions,<br>Extension and development Agencies<br>Policy makers, media, | Zaghouane Omar<br>Houassine Djamel |

| | | |
|---|---|---|
| Third workshop with field visit at the end of the season<br>(Period late May - early June) | | |

### Milestones

Three workshops organised by year with the participation of all partners involved and dissemination of maximum knowledge of CA and commitment of each partners in its role to promote the CA.

### 3.1.2. Morocco

### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | M. BOUGHLALA, | 5 |
| | O. ELGHARRAS, | 3 |
| | M. EL KOUDRIM | 3 |
| | M. EL GHAROUS | 2 |
| | E. EL MZOURI | 5 |
| | B. EL YOUSFI | 3 |
| | O. IBEN HALIMA | 2 |
| | Z. ABAIL | 2 |
| | M. DARID | 5 |
| AGENDA | A. El BRAHLI | 10 |
| RSSA | | |
| ICARDA | BOUBAKER | 5 |
| DPA | H. S. ZAGHLOUL | 1 |

### Milestones

| Workshop | Target group and participants | Responsibility |
|---|---|---|
| Inception Workshop (Period mid-October)<br>2nd workshop during the mid-growing season with a visit to the field<br>(Period late March and early April)<br>Third workshop with field visit at the end of the season<br>(Period late May - early June) | Farmers, Farmer Organizations, NGOs, Manufacturers, institutions,<br>Extension and development Agencies<br>Policy makers, media, | O. EL GHARRAS<br>A. EL BRAHLI<br>H. SAAD ZAGHLOUL |

### 3.1.3. Tunisia

#### Team in charge

| Scientist name | Institution | Time allocated | | | | |
|---|---|---|---|---|---|---|
| | | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 |
| Halim BEN HAJ SALAH | INGC | 10 | 10 | 10 | 10 | 10 |
| Houcine ANGAR | INGC | 10 | 10 | | 20 | 10 |
| Dorsaf HLEL | INGC | 20 | 20 | | 10 | |
| Bassem MOUELHI | INGC | | 10 | | | 30 |
| Hichem BELLAMINE | APAD | | | | 20 | |
| Hatem Cheikh Mhamed | INRAT | | | | 10 | |
| Amina Baccouri | APAD | | | | | 10 |

#### Workshops

| Workshops | Tentative date and location | Target groups/participants | Responsibility |
|---|---|---|---|
| National Inception workshop | End of October (One Day) Jendouba | Farmers, Farmer Organizations, NGOs, Manufacturers, Extension and development Agencies, Policy makers, Project Team, Media | H. BEN HAJ SALAH |
| Mid-growing season field visit | March, April (Two Days) Jendouba | | H. BEN HAJ SALAH |
| End season field visit | Mai to July (Two Days) Jendouba | | H. BEN HAJ SALAH |

## 3.2. Activity 3.2. Conduct on-job training of all stakeholders (farmers, extension, traders, scientists, NGOs)

### 3.2.1. Algeria

#### Team in charge

| Scientist name | Time allocated |
|---|---|
| Sersoub Djamel | 5 % |
| Houassine Djamel | 5 % |
| Zeghouane Omar | 5 % |

#### Justification

Needs for capacity building teams NARES and training stakeholders to promote the practice and development of CA.

#### Objective

Development of expertise to promoting CA through the conduct of on job training for all stakeholders

#### Materials and methods

- Selection of experts

- Selection of trainees in NARES and professionals (farmers, extension, traders, scientists, NGOs)

| Specialty/ theme | Tentative date and duration | Target group |
|---|---|---|
| Equipment's adjustment for seeding | 2 days/ November 2012 | 20 farmers and NGO's |
| Crops rotations management | 1 day/ March 2013 | 30 Farmers and NGO's |
| CA production system | 2 days/ April 2013 | 20 Extensionists and young scientists |
| Techniques of extension and Methodologies | 1 day/ April 2013 | 30 Farmers and extensionists |

### Milestones

- Local expertise developed in various fields to promote CA

### 3.2.2. Morocco

### 3.2.3. Tunisia

### Team in charge

| Scientist name | Institution | Time allocated | | | | |
|---|---|---|---|---|---|---|
| | | 3.1 | 3.2 | 3.3 | 3.4 | 3.5 |
| Halim BEN HAJ SALAH | INGC | 10 | 10 | 10 | 10 | 10 |
| Houcine ANGAR | INGC | 10 | 10 | | 20 | 10 |
| Dorsaf HLEL | INGC | 20 | 20 | | 10 | |
| Bassem MOUELHI | INGC | | 10 | | | 30 |
| Hichem BELLAMINE | APAD | | | | 20 | |
| Hatem Cheikh Mhamed | INRAT | | | | 10 | |
| Amina Baccouri | APAD | | | | | 10 |

### Trainings

| Themes | Tentative date and duration | Target groups/participants |
|---|---|---|
| No-Till and Soil Fertility enhancement | February/ 2 days | Extensionists – young scientists (20) |
| Soil Properties Modified By No-Till. | March (field training/ 1 day) | Farmers (30)– NGO's |
| Water Use Efficiency under No-Till Systems | April (2 days) | Extensionists – Young scientists (20) |
| No-Till Economic Benefits | May (1 days) | Farmers and NGO's (30) |

## 3.3. Activity 3.3. Use Australian experience to upgrade national expertise in CA through scientific and technical support, and exchange of visits and training that focus on systems analysis of longer term outcomes of CA

### 3.3.1. Algeria

#### Objective

Development of national expertise to promote CA by use Australian experience through exchange visits and training in field of systems analysis of longer term outcomes of CA results in the long term.

#### Materials and methods

- Choice of training topics;
- Choice of experts;
- Selection of trainees in the technical and scientific staff, and professionals (farmers, extension ...)
- Programming visits and training.

**Mobility of Algerian scientist to Australia**

| Scientist name | Specialty / theme | Tentative date and duration | Host |
|---|---|---|---|
| Houassine Djamel | Crop monitoring, and rotations | 2 weeks/ June 2013 | |

**Mobility of Australian and ICARDA experts to Algeria**

| Scientist name | Specialty / theme | Tentative date and duration | Host |
|---|---|---|---|
| Jack Desbiolles (Australia) | Select potential drills for adaptation and study | 1 week<br>December 2012 | Djamel Houassine |
| B. Dhibi (ICARDA) | Adoption and impact study, | 1 week for each<br>Between February and May 2013 | |
| Ali Nefzaoui (ICARDA) | Crop and livestock integration, | | |
| S. Loss | Residue management | | |

Milestones

Local expertise developed in various fields to promote CA.

### 3.3.2. Morocco

**Moroccan Scientists Mobility to Australia**

| | Scientist Name | Visit subject | Date and duration |
|---|---|---|---|
| Year 1 (2012/13) one visitor | M. El Koudrim | Crop/livestock integration opportunities for Morocco | 2 weeks |
| Year 2 (2013/14) Two visitors | Dr. Mohamed El Gharous | Policy and Organisation For CA | 2 week |

| | | | |
|---|---|---|---|
| | A. Chriqui | | |
| Year 3 (2014/15) one visitor | A. El Brahli | Organisation linkages and train the trainers | 2 weeks |
| Year 4 (2015/16) one visitor | Dr. Brahim El Youssfi | Pest Management under CA | 2 weeks |

**Australian scientists mobility to Morocco**

| | Scientist Name | Scientific subject | Objectives | Date and duration | host (ess) |
|---|---|---|---|---|---|
| Year 1 | Jacky Desbiolles | Drillers design and development | Improvement of ZT drills | 1 week | O. Gharras |
| | A. Mayfield | Crop rotation | Disease management | 1 week | H. El Koudrim |
| Year 2 | G. Gurjeet | Integrated Weed Management | Weed populations dynamics/ Modeling | 1 week | A. El Brahli |
| | Jacky Desbiolles | Drillers design and development | Improvement of ZT drills | 2 week | O. Gharras |
| Year 3 | J. Fortune | Extension and adoption evaluation | Impact assessment | 1 week | El. Mzouri |
| Year 4 | Angelo Loi | Mediterranean Forage and pasture legumes | Determination of best mixture composition for multi-species pastures | 1 week | M. El Koudrim |

**ICARDA's Scientists Mobility to NARS**

| | Scientist Name | Scientific subject | Date and duration | NARS host (ess) |
|---|---|---|---|---|
| Year 1 | A. Nefzaoui | Crop and livestock integration | 1 week | M. El Koudrim |

### 3.3.3. Tunisia

#### Tunisian scientists Mobility to Australia

| | Scientist Name | Visit subject | Date and duration | Australian host (ess) |
|---|---|---|---|---|
| Year 1 (2012/13) one visitor | 1 Machinery scientist (M. Jadlaoui) | Drills design and development | 2 weeks from 15 March 2013 | Jacky Desbiolles |

#### Australian Scientists Mobility to Tunisia

| | Scientist Name | Scientific subject | Objectives | Date and duration | host (ess) |
|---|---|---|---|---|---|
| Year 1 (2012/13) one visitor | Barry Mudge | Water use efficiency | Implementation of socioeconomic activities<br>Training | 1 week<br>1 week (April) | Boubaker Thabet/INAT<br>INGC |
| | Jacky Desbiolles | Drillers design and development | Improvement of local ZT drills | 1 week | M. Jadlaoui |

#### Tunisian Scientists Mobility to Algeria and morocco

| | Number of Participants | Name | Subject | Date and duration | host Country |
|---|---|---|---|---|---|
| Year 1 (2012/2013) | 08 | (03) Scientists | Regional annual meeting | 1 week | |
| | | (02) Scientists<br>(01) Farmer | (01) Machinery, Socioeconomist<br>(01) Farmer | 1 week | Morocco |
| | | (01) Scientists<br>(01) Farmer | 01 Agronomist<br>01 Farmer | 1 week | Algeria |

#### ICARDA's Scientists Mobility to Tunisia - Year 1

| | Scientist Name | Scientific subject | Date and duration | NARS host (ess) |
|---|---|---|---|---|
| Tunisia | D. Feindel | Crop rotation | 1 week | H. Chikh M'Hamed |
| | B. Dhibi | Adoption and impact study | 1 week | H.MAAROUFI |
| | R. Summer | APSIM test | 1 week | M. Annabi |

## 3.4. Activity 3.4. Conduct farmer field schools to enhance stakeholder co-learning and farmer-to-farmer innovation

### 3.4.1. Algeria

#### Team in charge

| Scientist name | Time allocated |
|---|---|
| Sersoub Djamel | 5 |
| Houassine Djamel | 5 |
| Laouar Abdelmalek | 5 |
| Makhlouf Mahfoud | 5 |
| Achiri Ali | 10 |
| Mahnane Said | 10 |

#### Justification

Create a center for CA technical innovation and transfer technology.

#### Objective

Development of expertise in CA, through conduct of five specialized farms field schools for training and transfer of knowledge and innovation.

#### Materials and methods

Implementation of program of training and extension at 5 farms field schools in five themes:

- ZT Machinery and crops installation (Farm SAGRODEV);
- Weeds management, diseases and insects IPM (Farm Khebaba);
- Crop and soil management, and risk management (Farm Dahel);
- Residue management and crop/livestock integration (Farm Sersour);
- Crop diversification and rotation (Farm Smata).

| Field schools | Specialty / theme | Target group | Tentative date and duration |
|---|---|---|---|
| (Farm SAGRODEV) | ZT Machinery and crops installation (equipment and techniques) | 10 stakeholder/group x 2 days (20 participants) | November 2012 |
| (Farm Khebaba) | Weeds management, diseases and insects IPM (equipment and techniques) | | January - February |
| (Farm Dahel) | Crop and soil management, and risk management (equipment and techniques) | | April – May |
| (Farm Sersour) | Residue management and crop/livestock integration (equipment and techniques) | | April - May |
| (Farm Smata) | Crop diversification and rotation (equipment and techniques) | | May |

#### Milestones

5 specialized farms field schools conducted and development of expert farmers to practice and dissemination of the CA.

### 3.4.2. Morocco

#### Team in charge

| Institutions | Staff | %TIME |
|---|---|---|
| INRA | O. ELGHARRAS, | 10 |
| | M. EL KOUDRIM, | 3 |
| | M. BOUGHLALA, | 5 |
| | Z. ABAIL, | 5 |
| | O. IBEN HALIMA, | 2 |
| | B. EL AMIRI, | 5 |
| | B. EL YOUSFI | 5 |
| AGENDA | A. EL BRAHLI, | 10 |
| | A. TANJI, | 5 |
| | N. EL HANATOUI | 5 |
| CT Oued Zem | M. .NAZIH, | 5 |
| | K. EL KILI, | 5 |
| | K. SOKRAT | 5 |
| Partners: Farmers | | |
| Input suppliers/importers | | |

#### Justification

Farmer Field School is an exchange opportunity where farmers, researchers and extension services can deliberate about a specific topic. It provides the opportunity of learning by doing to farmers and other stakeholders (service providers and others). It is also a forum where farmers and trainers debate observations, experiences and present new information from outside the community.

CA is a system based approach that need to be considered within the community and taking into consideration all the stakeholders. An FFS around CA should be held over the cropping season, taking into consideration the cropping system that fit the production system of the region and the farm needs.

#### Objective

The main objective for an FFS around CA is to enhance farmers' capacities and understanding of CA production systems.

#### Expected Output

- Farmers' organization to adapt and adopt CA production systems.
- Identify the cropping system that fit farmers' need and agro-climatic conditions.
- Raise the awareness of farmers for better planning for field work and organization.

#### Methodology

- Identify the group of farmers that will be involved in the FFS.
- Identify the field that will host the FFS and the crop rotation.
- Chose the facilitator and set a program.
- Select a program leader.

### 3.4.3. Tunisia

| Events | Tentative date and duration | Target groups/participants |
|---|---|---|
| No-Till Drillers: planting & crop establishment | November /2 days | Two Groups:<br>Farmers<br>Extensionists<br>Scientists<br>One Day for each Group (20 participant) |
| crop diversification & rotation | January /2days | |
| Integrated Pest Management (weeds, diseases, insect pest) | January- February/ 2 days | |
| Crop & soil management, & risk management | April /2 days | |
| residue management & crop/livestock integration | June- July /2 days | |

## 3.5. Activity 3.5. Enhance knowledge sharing and dissemination through brochures, newsletters, website and media

### 3.5.1. Algeria

#### Team in charge

| Scientist name | Time allocated |
|---|---|
| Amrani Ratiba | 20% |
| Amrani Mohamed | 20 % |
| Zeghouane Omar | 10 % |

#### Justification

Use of all means of communication, including information systems and websites for dissemination and exchange of information between farmers, professionals and scientists.

#### Objective

Improve the sharing and dissemination of knowledge through brochures, articles, websites and media.

#### Materials and methods

- At least 5 leaflets, biannual project of article on various topics, and project website produced and disseminated.
- Brochures (2012/2013)
- Brochure on agriculture conservation: no till in Algeria
- Brochure: presentation of the project.

Milestones

- Brochures, articles project of article produced and disseminated.

### 3.5.2. Morocco

#### Reports

- Establish PV and reports on progress meetings internally and with project partners

**Editions**

- Development of informative posters for information days and any other event
- Preparation of Posters
- Development of leaflets and brochures
- Contributions to the layout and completion of partial and final reports
- Edition of an annual report communication activities

**Media coverage of events**

- Edition bulletins event in the project (a collection of stories, photos, videos and reports)

**Media**

- Supervision of media covering the events and activities of the project
- Announcement of the events of the Project on national Radios (SNRT, Chada FM)

**Press**

- Writing two newspaper articles on the project and its main results 2012-2013

**Video**

- Development of a 15 min documentary on the project activities in 2012-2013

**WEB Site INRA**

- Supply web site INRA of various events of the project

### 3.5.3. Tunisia

| Year | Title |
|---|---|
| Year 1 (2012/2013) | “Adapting Conservation Agriculture for Rapid Adoption by Smallholder Farmers in North Africa” Project Presentation |
| | Principles and benefits of Conservation Agriculture |

## 3.6. Activity 3.6. Promote CA networking in the region aiming at establishing CA hub in North Africa

### 3.6.1. Algeria

### Justification

North Africannetworkthat will serve forknowledge sharingand consolidationofactions conductedatthree platforms

### Objective

Promote the CA through networking or development of a North African hub of the CA.

## Materials and methods

- At least NGOs / associationreinforced
- Held a regional inception workshop and a final workshop
- Regional and intra-regional exchange visits involving 5 scientists / extension workers and 4 farmers
- Linkages with other projects or CA initiatives in the MENA region.

| Number of participants | Name | Theme | Duration | Host country |
|---|---|---|---|---|
| 6 | - 3 scientists<br>- 3 extensionists | Extension,<br>Machinery,<br>Crop management | 1 week | Morocco |
| 1 | 1 Farmer | Exchange experience | 1 week | Tunisia |

# 4. Budget

## 4.1. Algeria

**Estimated budget for 2012-13 Algeria**

| Items | Objective | Sub-objective | Activity | ACIAR Contribution AUD | Algeria contribution AUD | Total AUD |
|---|---|---|---|---|---|---|
| Personnel | 1 | | 1.1 | 0 | 30 000 | 20 000 |
| | | | 1.2 | 0 | 15 000 | 10 000 |
| | 2 | 2.1 | 2.1.1 | 0 | 32 000 | 32 000 |
| | | | 2.1.2 | 0 | 28 000 | 28 000 |
| | | 2.2 | 2.2.1 | 0 | 31 000 | 31 000 |
| | | | 2.2.2 | 0 | 45 400 | 45 400 |
| | | | 2.2.3 | 0 | 40 200 | 40 200 |
| | | 2.3 | 2.3.1 | 0 | 41 100 | 28 100 |
| | | | 2.3.2 | 0 | 25 400 | 25 400 |
| | 3 | | 3.1 | 0 | 22 000 | 22 000 |
| | | | 3.2 | 0 | 35 000 | 35 000 |
| | | | 3.3 | - | - | - |
| | | | 3.4 | 0 | 29 600 | 29 600 |
| | | | 3.5 | 0 | 24 000 | 24 000 |
| | | Sub-total personnel | | 0 | 398 700 | 398 700 |
| Supplies and services | 1 | | 1.1 | 1 000 | 5 000 | 6 000 |
| | | | 1.2 | 1 000 | 6 000 | 5 000 |
| | 2 | | 2.1.1 | ? | ? | ? |
| | | | 2.1.2 | | 6 000 | |
| | | | 2.1.3 | ? | ? | ? |
| | | | 2.2.1 | 8 000 | 19 000 | 25 000 |
| | | | 2.2.2 | 5 500 | 18 300 | 23 800 |
| | | | 2.2.3 | 4 700 | 23 000 | 27 700 |
| | | | 2.3.1 | 4 000 | 20 000 | 18 000 |
| | | | 2.3.2 | 5 000 | 36 000 | 35 000 |
| | 3 | | 3.1 | 1 000 | 19 000 | 20 000 |
| | | | 3.2 | 2 000 | 25 000 | 22 000 |
| | | | 3.3 | - | - | - |
| | | | 3.4 | 5 000 | 40 000 | 45 000 |
| | | | 3.5 | 5 000 | 34 000 | 24 000 |
| | | Sub-total supplies and services | | 42 200 | 251 300 | 293 500 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Travel | | | | 37 314 | | 37 314 |
| | | Sub-total travel | | 37 314 | | 37 314 |
| Capital items | 1 | 1.1 et 1.1 | | | 6 000 | 6 000 |
| | 2 | 2.1 | 2.1.1 | 30 000 | | 30 000 |
| | | | 2.1.2 | | 20 000 | 12 000 |
| | | | 2.1.3 | 16 000 | 25 000 | 41 000 |
| | | 2.2 | 2.2.1 | | 14 200 | 14 200 |
| | | | 2.2.2 | | 13 500 | 13 500 |
| | | | 2.2.3 | 17 000 | 17 000 | 34 000 |
| | | 2.3 | 2.3.1 | | | |
| | | | 2.3.2 | | 6 000 | 6 000 |
| | 3 | | 3.1 | | 4 000 | |
| | | | 3.2 | | | |
| | | | 3.3 | | | |
| | | | 3.4 | | 8 000 | |
| | | | 3.5 | | | |
| | | | Vehicle | 25 000 | 40 000 | 60 000 |
| | Sub-total capital items | | | 88 000 | 153 700 | 241 700 |
| Total | | | | 167 514 | 803 700 | 971 214 |

## 4.2. Morocco

### Estimated budget for 2012-13 Morocco

| | |
|---|---|
| Field Operations, Supplies | |
| Field operations, organization and logistics | 12.000 |
| Materials, supplies, seeds, fertilizers, fungicides…. | 18.000 |
| Field labor | 8.000 |
| Sites establishment, surveys and analysis of data | 6.000 |
| Communication, email etc. | 2.000 |
| Local travel | 5.000 |
| Thematic groups' field demonstrations and consultations | 4.000 |
| Local scientific and technical backstopping | 4.000 |
| Total field operations | 59000 |
| | |
| Capacity development (training courses, workshops, scientific visits etc.) | |
| Scientist and Farmer-exchange visits (Intern. traveling workshops) | 12.000 |
| Farmers' field days, farmers' schools etc. | 5.000 |

| | |
|---|---|
| Short-term international training for researchers and extension staff | 13.000 |
| Total capacity building | 30.000 |
| | |
| Policy Advocacy and Knowledge Dissemination | |
| Dissemination material | 2.000 |
| Reports and proceedings | 2.000 |
| Total advocacy | 4.000 |
| Capital Items | |
| Equipment | 74.000 |
| Miscellaneous | 4.000 |
| TOTAL | 171.000 |

## 4.3. Tunisia

### Estimated budget for 2012-13 Tunisia

| Items | Activity | ACIAR funds | Tunisia funds |
|---|---|---|---|
| Personal costs | Obj 1 (1.1. and 1.2.) | 0 | 36000 |
| | 2.1. | 0 | 42000 |
| | 2.2.1 | 0 | 37000 |
| | 2.2.2. | 0 | 34500 |
| | 2.2.3 | 0 | 42000 |
| | 2.3.1. | 0 | 43500 |
| | 2.3.2. | 0 | 38500 |
| | 3.1. | 0 | 27000 |
| | 3.2. | 0 | 28000 |
| | 3.3. | 0 | |
| | 3.4. | 0 | 22500 |
| | 3.5. | 0 | 27000 |
| | Sub-total | 0 | 378000 |
| Supplies and services | Obj 1 (1.1. and 1.2.) | 4200 | 12000 |
| | 2.1.1. | 5300 | |
| | 2.1.2. | | 11000 |
| | 2.1.3. | 4000 | 5400 |
| | 2.2.1 | 4100 | 17000 |
| | 2.2.2. | 6545 | 18200 |
| | 2.2.3 | 4400 | 28070 |
| | 2.3.1. | 3500 | 18650 |

| | | | |
|---|---|---|---|
| | 2.3.2. | 3000 | 43000 |
| | 3.1. | | 25000 |
| | 3.2. | 2000 | 28000 |
| | 3.3. | | |
| | 3.4. | 3000 | 36000 |
| | 3.5. | 2000 | 39500 |
| | Sub-total | 42045 | 281820 |
| Travel | 3.3. | 37314 | 0 |
| capital items | Obj 1 (1.1. and 1.2.) | 4000 | 4000 |
| | 2.1.1. | 30000 | |
| | 2.1.2. | | 16000 |
| | 2.1.3. | 16000 | 21000 |
| | 2.2.1 | | 17750 |
| | 2.2.2. | 4000 | 12550 |
| | 2.2.3 | | 12000 |
| | 2.3.1. | 4000 | |
| | 2.3.2. | 1000 | 5500 |
| | 3.1. | | 3500 |
| | 3.2. | | |
| | 3.3. | 4000 | |
| | 3.4. | | 7700 |
| | 3.5. | | |
| | Field vehicle | 25000 | 50000 |
| | Sub-total | 88000 | 150000 |
| Sub-total | | 167359 | 809820 |
| Infrastructure cost | 5% | 3968 | 0 |
| Total | | 171327 | 809820 |

# 5. Research teams

## 5.1. Algeria

Project team Algeria

| Name | Sex (m/f) | Agency and position | Discipline and role in project | Time input (%) | Funding |
|---|---|---|---|---|---|
| Omar Zeghouane | M | ITGC scientist/ Director | Agronomist, Director ITGC. Administrative coordination<br>Objective 1, 2, 3 | 30 | ITGC/MOA |
| Djamel Houassine | M | ITGC scientist | Project coordinator. Agronomist. Crop monitoring and rotation<br>Objective 1, 2, 3 | 60 | ITGC/MOA |
| Youcef Ghalem | M | ITGC scientist | Ag-engineer. ZT seeder design and testing<br>Objective 2, 3 | 40 | ITGC/MOA |
| Kahina Oumedjkane | F | ITGC scientist | Socio-economics. Adoption and impact assessment<br>Objective 1 | 50 | ITGC/MOA |
| Farida Djenadi | F | ITGC scientist | Agronomist. Crop monitoring<br>Objective 2 | 25 | ITGC/MOA |
| Abdelmalek Laouar | M | ITGC scientist | Agronomist. On-farm trials and dissemination<br>Objective 2 | 50 | ITGC/MOA |
| Ratiba Amrani | F | ITGC specialist | Communication and Documentation, Head of Dept.<br>Objectives 1, 3. | 20 | ITGC/MOA |
| Mohammed Amrani | M | ITGC specialist | Design & editing specialist<br>Objective 1, 3 | 20 | ITGC/MOA |
| Zahia Rahim | F | INPV scientist | Plant pathologist. Integrated disease management<br>Objective 2 | 10 | INPV/MOA |
| Said Mahnane | M | Trait d'Union, NGO | Socio-economic and transfer of technology.<br>Objective 1, 3 | 10 | Trait d'Union/MOA |
| Ali Achouri | M | Trait d'Union, NGO | Farmer and President of Trait d'Union, NGO | 10 | Trait d'Union/MOA |
| Fatiha Harrad | F | PMAT | Private entrepreneur Manufacture of ZT seeders<br>Objective 2, 3 | 30 | PMAT/MOA |
| Djamel Sersoub | M | ITGC manager | Management<br>Director of station | 30 | ITGC/MOA |
| Djamel Soukehal | M | HCDS, scientist | Rangeland & livestock specialist. Residue management and alternative feed resources<br>Objective 2, 3 | 20 | HCDS/MOA |
| Lakhdar Brouri | M | HCDS, scientist | Rangeland & livestock specialist. Residue management and | 20 | HCDS/MOA |

| Name | Sex | Agency and position | Discipline and role in project | Time input (%) | Funding |
|---|---|---|---|---|---|
| | | | alternative feed resources<br><br>Objective 2, 3 | | |
| Khaled Abbas | M | INRAA scientist | Agronomist. Integrated weed management<br>Objective 2 | 20 | INRAA/MOA |
| Djamila Siad | F | ITGC scientist | Soil scientist. Soil assessment and monitoring<br>Objective 2 | 30 | ITGC/MOA |
| Lydia Chaou | F | ITGC scientist | Agronomist. Crop monitoring<br>Objective 2 | 10 | ITGC/MOA |
| Zohra Benlakehal | F | ITGC scientist | Forestry and Conservation<br>Objective 2 | 10 | ITGC/MOA |
| Djamila Taieb | F | ITGC scientist | Chemist Soil assessment and monitoring<br>Objective 2 | 10 | ITGC/MOA |
| Larbi Bouhaouchine | M | ITGC scientist | Socio-economics. Adoption and impact assessment<br>Objective 1 | 25 | ITGC/MOA |
| Lila Saidi | F | ITGC scientist | Agricultural water management.<br>Objective 2 | 10 | ITGC/MOA |
| Hocine Bendada. | M | ITGC scientist | Agronomist. On-farm trials and dissemination<br>Objective 2,3 | 20 | ITGC/MOA |
| Bilal Fortas | M | ITGC scientist | Agronomist. On-farm trials and dissemination<br>Objective 2,3 | 20 | ITGC/MOA |
| Mahfoud Makhlouf | M | Trait d'Union, NGOs | Vice President of Trait d'Union, Agronomist<br>NGOs<br>Objective 1, 2,3 | 50 | Trait d'union/MOA |
| Koussa Abderrezak | M | Trait d'Union, NGOs | Agronomist<br>Objective 2 | 10 | Trait d'union/MOA |
| Abdelghani Belguendouz | M | Trait d'Union, NGOs | Agronomist | 15 | Trait d'union/MOA |
| Atef Alla-Eddine Amriche | M | INSID scientist | Soil & water scientist. Soil moisture assessment and monitoring<br>Objective 2 | 25 | INSIDMOA |
| Pr. Hafsi Miloud | M | University Setif, scientist | Agronomist. Crop monitoring, advising students and linkages with universities<br>Objective 2, 3 | 20 | UNIVERSITY/MOA |
| Dr. Djenene Abdelmajid | M | University Setif, scientist | Socio-economics. Adoption and impact assessment<br>Objective 1 | 15 | UNIVERSITY/MOA |
| Dr. Makhlouf Abdelhamid | M | University Setif, scientist | Agronomist. Crop monitoring, advising students and linkages with universities<br>Objective 2, 3 | 10 | UNIVERSITY/MOA |

| Name | Sex | Agency and position | Discipline and role in project | Time input (%) | Funding |
|---|---|---|---|---|---|
| Rouabhi Amar | M | University Setif, scientist | Agronomist. Socio-economics, modeling advising students and linkages with universities<br>Objective 1, 2, 31 | 10 | UNIVERSITY/MOA |
| Hamena Bouzerzour | M | University Setif, scientist | Agronomist. Crop monitoring, advising students and linkages with universities | 10 | UNIVERSITY/MOA |

## 5.2. Morocco

| Name | Sex | Discipline and role in project | Time input | Funding |
|---|---|---|---|---|
| M. Boughlala | M | | 50 | |
| O. El-Gharras | M | | 90 | |
| M. El Koudrim | M | | 54 | |
| O. Benhalima | F | | 37 | |
| A. El Brahli | M | | 55 | |
| A. Tanji | M | | 23 | |
| B. Dhehibi | M | | 20 | |
| H. S. Zaghloul | M | | 5 | |
| A. El Aissaoui | M | | 25 | |
| N. El Hanatoui | M | | 20 | |
| Pr H. Fassi Fihri | M | | 15 | |
| M. Tabia | M | | 30 | |
| M. Nazih | M | | 8 | |
| E. Bourrarach | M | | 15 | |
| M. Idrissi | M | | 20 | |
| B. Hajaj | M | | 10 | |
| B. El Yousfi | M | | 26 | |
| Z. Abail | F | | 28 | |
| M. El Gharous | M | | 15 | |
| R. Moussadek | M | | 10 | |
| H. Ouabbou | M | | 10 | |
| B. El Amiri | F | | 15 | |
| K. El Kili | M | | 8 | |
| K. Sokrat | M | | 8 | |

| | Activity | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | 1.1 | 1.2. | 2.1.1. | 2.1.2. | 2.1.3. | 2.2.1 | 2.2.2. | 2.2.3 | 2.3.1. | 2.3.2. | 3.1. | 3.2. | 3.3. | 3.4. | 3.5. | Total |
| M. Boughlala | 5 | 5 | 5 | 5 | | 5 | | | 5 | | 5 | | | | | 5 |
| O. El-Gharras | 5 | 5 | 5 | 5 | 2 | 5 | 20 | 15 | 5 | | 3 | 3 | | 2 | 2 | |
| M. El Koudrim | 3 | 3 | 3 | 3 | | | | | | | 3 | | | | | 3 |
| O. Benhalima | 1 | | 1 | 1 | | | | | | | 4 | 5 | | 5 | 5 | 3 |
| A. El Brahli | 2 | 2 | 2 | 2 | 2 | | | 2 | 1 | 5 | 10 | 5 | 3 | 1 | 5 | |
| A. Tanji | 2 | | | 1 | | | | | | 10 | 5 | | | | | |
| B. Dhehibi | 5 | 5 | 5 | 5 | | | | | | | | | | | | |
| H. S. Zaghloul | 1 | 1 | 1 | 1 | | | | | | | | | | | | |
| A. El Aissaoui | | | | | 5 | 5 | 5 | 5 | 5 | | | | | | | |
| N. El Hanatoui | | | | | 5 | 5 | | | 5 | | | | | | | |
| Pr H. Fassi Fihri | | | | | | 5 | 5 | 5 | | | | | | | | |
| M. Tabia | | | | | | 15 | 15 | | | | | | | | | |
| M. Nazih | | | | 1 | | 1 | | | | | 1 | | | | | |
| E. Bourrarach | | | | | | | 10 | 5 | | | | | | | | |
| M. Idrissi | | | | | | | 5 | 5 | 10 | | | | | | | |
| B. Hajaj | | | | | | | | | | 10 | | | | | | |
| B. El Yousfi | | | | 1 | | | | | | | 10 | | 10 | | | |
| Z. Abail | | | | 1 | | | | | | | 5 | 5 | | 5 | 5 | 5 |
| M. El Gharous | | | | | | | | | | | | 5 | | 5 | 5 | |
| R. Moussadek | | | | | | | | | | | | | | | | 10 |
| H. Ouabbou | | | | | | | | | | | | | | | | 10 |
| B. El Amiri | | | | | | | | | | | | | | | | |
| K. El Kili | | 1 | 1 | | | | | | | | | | | | | |
| K. Sokrat | | 1 | 1 | | | | | | | | | | | | | |

## 5.3. Tunisia

| Name | Sex (m/f) | Agency and position | Discipline and role in project | Time input (%) | Funding |
|---|---|---|---|---|---|
| Halim Ben Haj Salah | M | INGC, scientist/ Director | Agronomist. Project management and coordination<br>Objectives 1, 2, 3 | 50 | INGC |
| Hayet Maaroufi | F | INGC, scientist | Ag-economist; Adoption & impact studies<br>Objective 1 | 50 | INGC |
| Raja Nabli | F | INGC scientist | Socio-economic, adoption & impact studies<br>Objective 1 | 20 | INGC |
| Dorsaf Hlel | F | INGC, scientist | Agronomist. Baseline surveys and data base<br>Objective 1 | 50 | INGC |
| Mohamed Jadlaoui | M | INGC, scientist | Ag-engineer. ZT seeder design & testing<br>Objective 2, 3 | 70 | INGC |
| Mohammed Ali Hannachi | M | INGC, scientist | Ag-engineer. ZT seeder design & testing<br>Objective 2 | 30 | INGC |
| Houcine Angar | M | INGC, scientist | Agronomist. On-farm trials and transfer of technology<br>Objective 1, 2, 3 | 80 | INGC |
| Bassam Mouelhi | M | INGC specialist | Information, Communication and Documentation, Head<br>Objectives 1, 3 | 60 | INGC |
| Thouraya Souissi | F | INAT, scientist | Agronomist. Weed management and crop rotation; coordination with universities<br>Objective 2 | 25 | MOA |
| Hassan Kharoubi | M | ESIER, scientist | Ag-engineer. ZT machinery testing<br>Objective 2, 3 | 30 | MOA |
| Boubaker Thabet | M | INAT, scientist | Ag. Economics. Policy and institution, economic modeling, advising students and linkages with Australian universities<br>Objective 1, 3 | 25 | MOA |
| Nadira Ben Aissa | F | INAT, scientist | Soil scientist. Soil quality assessment and monitoring, crop rotation<br>Objective 2 | 25 | MOA |
| Sourour Abidi | F | INRAT, Scientist | Animal scientist. Livestock feeding, alternative feed resources<br>Objective 2 | 45 | MOA |
| Mohammed Annabi | M | INRAT, Scientist | Environmental Scientist. Soil erosion assessment and monitoring<br>Objective 2 | 30 | MOA |
| Salah Ben Youssed | M | INRAT, Scientist | Agronomist. Forage production and crop rotation<br>Objective 2 | 30 | MOA |
| Hatem EchikhMhamed | M | INRAT, Scientist | Agronomist. Crop monitoring and rotation<br>Objective 2 | 50 | MOA |
| Samia Gargouri | F | INRAT, Scientist | Plant pathologist. Integrated disease management<br>Objective 2 | 15 | MOA |
| Leith Ben Bechr | M | APAD, NGO | Farmer and president of APAD, NGO. Technology transfer and dissemination | 10 | APAD |

| | | | | | |
|---|---|---|---|---|---|
| | | | Objective 1, 3 | | |
| Hichem Belamine | M | APAD, NGO | | 20 | APAD |
| Amina Baccouri | F | APAD, NGO | Farmer and vice-president of APAD, NGO. Technology transfer and dissemination<br>Objective 1, 3 | 10 | APAD |

## Time allocated per team member (Tunisia)

| | Activity | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name | 1.1 | 1.2. | 2.1.1. | 2.1.2. | 2.1.3. | 2.2.1 | 2.2.2. | 2.2.3 | 2.3.1. | 2.3.2. | 3.1. | 3.2. | 3.3. | 3.4. | 3.5. | Total |
| Halim BEN HAJ SALAH | | | | | | | | | | | 10 | 10 | 10 | 10 | 10 | 50 |
| Boubaker Thabet (INAT) | 15 | 10 | | | | | | | | | | | | | | 25 |
| Maâroufi Hayet (INGC) | 20 | 20 | | 5 | 5 | | | | | | | | | | | 50 |
| Raja Nabli (INGC) | 10 | 10 | | | | | | | | | | | | | | 20 |
| M. Jadlaoui (INGC) | | | 30 | 10 | 30 | | | | | | | | | | | 70 |
| M. Ali Hannachi (INGC) | | | 5 | 20 | 5 | | | | | | | | | | | 30 |
| Hassan kharoubi (ESIER) | | | 5 | 5 | 20 | | | | | | | | | | | 30 |
| Thouraya Souissi (Leader, INAT) | | | | | | 20 | 5 | | | | | | | | | 25 |
| Hatem Cheikh M'hamed (INRAT) | | | | | | 10 | 20 | 5 | 5 | | | | | 10 | | 50 |
| Salah Ben Youssef (INRAT) | | | | | | 5 | 5 | | 10 | 10 | | | | | | 30 |
| Messaad Khamassi (INGC) | | | | | | 30 | 10 | | | | | | | | | 40 |
| Houcine Angar (INGC) | | | | | | 10 | 20 | | | | 10 | 10 | | 20 | 10 | 80 |
| Naima Ben Bahri (INGC) | | | | | | 30 | | | | | | | | | | 30 |
| Samia Gargouri | | | | | | | 5 | 10 | | | | | | | | 15 |
| Mohamed Annabi | | | | | | | 5 | 20 | 5 | | | | | | | 30 |
| Sourour Abidi | | | | | | | 5 | | 20 | 20 | | | | | | 45 |
| Nadhira Ben Aissa | | | | | | | 5 | 20 | | | | | | | | 25 |
| Anis Bouselmi | | | | | | | | 20 | | | | | | | | 20 |
| Bassem MOUALHI | | | | | | | | | 10 | 10 | | 10 | | | 30 | 60 |
| Hichem Ben Salem | | | | | | | | | 1,5 | 1,5 | | | | | | 3 |
| Dorsaf HLEL | | | | | | | | | | | 20 | 20 | | 10 | | 50 |
| Hichem BELLAMINE | | | | | | | | | | | | | | 20 | | 20 |
| Amina Baccouri | | | | | | | | | | | | | | | 10 | 10 |

## Objectives, responsibility and activities team

| Objective | Objective responsibility | Activity | Activity responsibility | Members |
|---|---|---|---|---|
| 1.To identify constraints to adoption of CA by smallholder farmers and ways of enhancing adoption, most importantly identifying and testing socioeconomic options | Boubaker THABET | 1.1 | Boubaker THABET | Hayet MAAROUFI, Raja NEBLI, Amina BACCOURI |
| | | 1.2 | Boubaker THABET | Hayet MAAROUFI, Raja NEBLI |
| | | 1.3 | Boubaker THABET | Hayet MAAROUFI, Raja NEBLI |
| | | 1.4 | Boubaker THABET | Hayet MAAROUFI, Raja NEBLI |
| | | 1.5 | Boubaker THABET | Hayet MAAROUFI, Raja NEBLI |
| | | 1.6 | Boubaker THABET | Hayet MAAROUFI, Raja NEBLI |
| 2.1. Develop and test affordable ZT seeding machinery and crop establishment systems for small to medium sized farms | Mohamed Jadlaoui | 2.1.1 | Mohamed Jadlaoui | Hassen KHARROUBI, Mohamed Ali HANNACHI |
| | | 2.1.2 | Mohamed Jadlaoui | Hassen KHARROUBI, Mohamed Ali HANNACHI |
| | | 2.1.3 | Mohamed Jadlaoui | Hassen KHARROUBI, Mohamed Ali HANNACHI |
| | | 2.1.4 | Houcine ANGAR | Mohamed Jadlaoui Hassen KHARROUBI, Mohamed Ali HANNACHI |
| | | 2.1.5 | Mohamed Jadlaoui | Hassen KHARROUBI, Mohamed Ali HANNACHI |
| 2.2. Fine-tune weed management and crop sequences for sustainable land & water management | Hatem CHEIKH M'HAMED | 2.2.1 | Thouraya Souissi | Hatem CHEIKH M'HAMED, Salah BEN YOUSSEF, Messaed KHAMMESSI |
| | | 2.2.2 | Salah BEN YOUSSEF | Hatem CHEIKH M'HAMED, Nadhira BEN ISSA, Samia GARGOURI |
| | | 2.2.3 | Mohamed ANNABI | Hatem CHEIKH M'HAMED, Nadhira BEN ISSA, Samia GARGOURI, Anis BOUSELMI |
| | | 2.2.4 | Mohamed ANNABI | Salah BEN YOUSSEF, Nadhira BEN AISSA, Hatem |
| 2.3. Optimize crop residue management and livestock feeding under CA systems. | Sourour LAABIDI | 2.3.1 | Sourour Laabidi | Hichem BEN SALEM, Hatem CHEIKH M'HAMED, Bassem MOUALHI |
| | | 2.3.2 | Salah BEN YOUSSEF | Bassem MOUALHI |

| | | | | |
|---|---|---|---|---|
| | | 2.3.3 | Boubaker THABET | Hayet MAAROUFI, Raja NEBLI |
| 3. To enhance the capacity of NARES staff and other stakeholders to practice and promote CA | Halim Ben Haj Salah | 3.1 | Halim Ben Haj Salah | Houcine ANGAR |
| | | 3.2 | Houcine ANGAR | Bassem MOUALHI |
| | | 3.4 | Houcine ANGAR | Hichem BELAMINE (APAD), Hatem CHEIKH M'HAMED, Dorsaf HLEL |
| | | 3.5 | Bessem Moualhi | Amina Baccouri, Houcine ANGAR |
| | | 3.6 | Halim Ben Haj Salah | Houcine ANGAR, Leith BEN BECHER |