



CANA/ ACIAR Project CSE-2011-025

Report of visits to Morocco, Algeria and Tunisia

March - April, 2013

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Key proposed actions

For further details and see individual platform reports.

1. Weed management

Weed control should be an increased priority in the programs:

- 1) A plan for the proposed “Guide for weed management” should be developed in the near future so the required information (including results of additional field trials) can be compiled.
- 2) Herbicide test strips, using different timings, rates and mixtures should be included at relevant trial sites to provide additional information on weed control as well as for demonstrations for farmers and extension officers.
- 3) There should also be a review of the availability of practical, and effective boom sprayers, and good extension information on weed management, including herbicide spraying, appear to be worthwhile objectives for improving weed control and crop yields.
- 4) Convene a workshop for project participants on weed management, including weed biology, herbicide application and herbicide resistance.

2. Soil quality and plant rooting depth.

- 1) When assessing soil profiles estimates of rooting depth of the range of crops grown should be made, if not being done already. Consider rapid options such as “dig sticks” (open faced small cores hit into the ground) to assess soil moisture and crop rooting depth and distribution
- 2) The DNA root pathogen tests should be considered for the other platforms as well, after a review of the pathogen sampling program in Tunisia.

3. Crop nutrition

- 1) Plant leaf tissue tests should be done in field trials to assess the status of major and minor nutrients.
- 2) Nitrogen and phosphorus fertiliser rate recommendations for trials and farmer crops be reviewed to assess if application rates can be refined to better match crop requirements.

4. Crop sequences

Reconsider the place of canola in crop sequences and as a grain and forage crop.

5. Staff visits to Australia

It is recommended that Mr Laouar Abdelmalek (project coordinator at Setif), as well as Mr Djamel Houassine (the Algerian project coordinator) visits Australia this year to study CA techniques and that this visit be combined with that of Mr. Azeddine El Brahli.

Key comments from the visit to the all platforms - Morocco, Algeria and Tunisia

The program visits for all three platforms was very well organised. In the short time available we visited most of the trial sites, met most of the staff involved and heard project summaries for each of the project officers. A highlight of these visits was the opportunity to meet local farmers to learn more about their practices and the experiences with conservation agriculture.

Given the relatively short notice for planning and implementing trials most trials were very well done. In the trial set-up phase in the first year some crops were not sown into ideal situations – this should be less of a problem in the future years. There were some instances of the late arrival of crop inputs (such as seed and herbicides) which are likely to be less of an issue in future years. Also bad weather (snow in Algeria and heavy rainfall in Tunisia) delayed the application of some fertiliser and herbicide treatments.

Comments on addressing the 2012/13 Plan of Work

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

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.

There seems to be a need to test more herbicides treatments (chemicals, mixtures and timings) on a range of weeds and seeding systems, in addition to the herbicide treatments already in the trial program. This is to see if weed control can be improved as well as to compile practical weed control information for farmers and extension officers. These treatments should also assess impacts of weed densities and treatment timings on crop grain yield if this is not currently known for these platform regions. There is a lot of similarity with some weed species in crops in these regions and weeds in Southern Australia and so Australian herbicide efficacy information may be useful to guide the design of herbicide trials in North Africa.

Spray equipment appears to be a limitation. There should also be a program to review the availability of boom sprayers, including small hand-pulled boom sprays, and if necessary, develop appropriate equipment for both commercial and field experiment use.

Current spraying practices should also be reviewed to see if efficacies can be improved. These include the use low drift or low pressure air induction nozzles, reducing water rates (especially for glyphosate) improving boom stability and boom height above the canopy. Water used for spraying should be tested for carbonates to see if additives (e.g., ammonium sulphate) or alternative water sources are required to improve the efficacy of the glyphosate.

Proposed Actions:

- a) Review information available for the optimisation of spraying systems and their availability for trial and farming needs.
- b) A plan for the proposed “Guide for weed management” should be developed in the near future so the required information (including results of additional field trials) can be compiled.

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

Although canola was listed in the Draft Plan of Work, there was in fact very little in the trials. Comments made about this (which need to be followed-up for more details) were the lack of seed availability (in Algeria) and lack of markets (in Tunisia). An oilseed crop would be a useful disease break in the planned intensive cereal/legume rotations. There are also potential in-season grazing opportunities with oilseed crops, such as canola.

Most of the crops sequencing trials do not include current farmer practice (e.g. weedy fallow or deep tillage in spring) as alternatives. Given that the project is encouraging practice change amongst farmers, it may be appropriate to include current practice as a control.

Proposed Action: Review current knowledge of canola in the CANA region with a focus on practices that can maximise its value in rotations.

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

Even though a lot of measurements are being made of key components of soil fertility and structure, one of the additional measurements that should be made is to assess the rooting depth for the range of crops in the different soil types in the trial areas. One of the limitations in this program is the lack of suitable soil corers to readily sample soil to rooting depth, especially to measure soil water to crop rooting depth.

Crop nutrient status should be assessed using leaf tissue testing, especially for trace elements as well as the uptake of major nutrients, such as phosphorus.

Proposed Action: Consider rapid options such as “dig sticks” (open faced small cores hit into the ground) to assess soil moisture and crop rooting depth and distribution

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

Given the discussion about how to fence and graze the grazing areas in the residue trials, there needs to be further discussion with the respective project officers.

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

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

General issues here included late sowing of the alley species, which could affect survival over summer (especially the atriplex). These will require monitoring and, if necessary, watering over summer. Weed control in the adjacent forage strips was compromised, due to spray drift risk. This may impact on any future assessment of the impact of alley rows on the yield of adjacent crops.

Itinerary

Group composition:

Patrick Wall (Representing ACIAR),
 Barry Mudge, Allan Mayfield (Rural Solutions SA)
 Ali Nefzaoui (ICARDA and Acting Project Coordinator)
 Oussama El Gharras, Mohamed El Koudrim (Moroccan Platform)
 Djamel Houassine, Djamila Siad (Algerian Platform)
 Houcine Angar, Salah Ben Youssef (Tunisian Platform)

Date	Activity	Accompanying person
Sunday 24 March	Arrival to Casablanca and transfer to Rabat	Oussama El Gharras (CANA project national coordinator)
<i>Sunday 24 March night in Rabat</i>		
Monday 25 March		
Morning:	Meeting INRA official in Rabat (DG INRA, Dr R. Dahan and Dr R. Mrabet)	Oussama El Gharras
Afternoon	Travel to Settlat and visit of INRA Settlat Center (meeting Mohamed ElGharouss, Director Settlat Center)	Oussama El Gharras
<i>Monday 25 March night in Casablanca</i>		
Tuesday 26 March	Field visit of Moroccan CANA Project platform with Moroccan team	Oussama El Gharras + CANA Moroccan team*
<i>Tuesday 26 March night in Casablanca</i>		
Wednesday 27 March	Field visit of Moroccan CANA Project platform with Moroccan team	Oussama El Gharras + CANA Moroccan team*
<i>Wednesday 27 March night in Casablanca</i>		
Thursday 28 March	Travel to Algeria (Royal Air Maroc 560 – 10:55-13:50) and meeting with ITGC Director General	Omar Zaghouane, DG ITGC
<i>Thursday 28 March night in Algiers</i>		
Friday 29 March	Travel to Setif and visit of the Algerian platform	Omar Zaghouane, DG ITGC & national coordinator CANA project
<i>Friday 29 March night in Setif</i>		
Saturday 30 March	Visit of Setif platform (ctd.) and return to Algiers	Omar Zaghouane + CANA Algerian team**
<i>Saturday 30 March night in Algiers</i>		
Sunday 31 March	Visit of ITGC HQ and meeting with NARES officials	Omar Zaghouane
	Fly to Tunis Air Algeria 4000 16:00-18:20	
<i>Sunday 31 March night in Tunis</i>		
Monday 01 April	Departure to Fernana	Halim Ben Haj Salah
	Visit to Tunisia platform	Halim Ben Haj Salah + CANA national team Tunisia***

<i>Monday 01 April night in Béja</i>		
Tuesday 02 April		
Morning	Visit to Tunisia platform (ctd.)	Halim Ben Haj Salah + CANA national team Tunisia***
Afternoon	Meeting CANA team at INGC Bou-Salem	Halim Ben Haj Salah, DG INGC & national coordinator CANA project
<i>Tuesday 02 April night in Tunis</i>		
Wednesday 03 April		Halim Ben Haj Salah + CANA national team Tunisia***
Morning	Meetings in Tunis (President IRESA, DG INRAT)	Halim Haj Salah & Ali Nefzaoui
Afternoon	Training course on water use efficiency under CA system	The whole group
<i>Wednesday 03 April night in Tunis</i>		
Thursday 04 April	Training course on water use efficiency under CA system (ctd.1)	The whole group
<i>Thursday 04 April night in Tunis</i>		
Friday 05 April		
Morning	Training course on water use efficiency under CA system (ctd. 2)	The whole group
Afternoon	Wrap up meeting at ICARDA Tunis Office with Mohamed El Mourid	The whole group
Saturday 06 April	Departure of participants	

(*) **CANA Moroccan team:** M. Boughlala ; O. El-Gharas ; M. El Koudrim ; O. Benhalima ; A. El Brahli ; A. Tanji ; H. S. Zaghloul; A. El Aissaoui; N. El Hanatoui; Pr H. FassiFihri; M. Tabia; M. Nazih; E. Bourrarach; M. Idrissi; B. Hajaj; B. El Yousfi; Z. Abail; M. El Gharous; R. Moussadek; H. Ouabbou; B. El Amiri; K. El Kili; K. Sokrat

(**) **CANA Algerian team:** Omar Zaghouane; DjamelHouassine; YoucefGhalem; KahinaOumedjkane; Farida Djenadi; AbdelmalekLaouar; RatibaAmrani; Mohammed Amrani; Zahia Rahim; Said Mahnane; Ali Achouri; FatihaHarrad; DjamelSoukhal; LakhdarBrouri; Khaled Abbas; DjamilaSiad; Lydia Chaou; ZohraBenlakehal; DjamilaTaieb ; LarbiBouhaouchine ; Lila Saidi ; HocineBendad ; Bilal Fortas ; MahfoudMakhlouf ; KoussaAbderrezak ; AbdelghaniBelguendouz ; AtefAlla-EddineAmriche; Pr. HafsiMiloud ; Dr. DjeneneAbdelmajid; Dr. MakhloufAbdelhamid; Ms. Rouabhi Amar; HamenaBouzerzour.

(***) **CANA Tunisian team:**Halim BEN HAJ SALAH; BoubakerThabet (INAT); MaârroufiHayet (INGC); Raja Nabli (INGC); M. Jadlaoui (INGC); M. Ali Hannachi (INGC); Hassan kharoubi (ESIER); ThourayaSouissi (Leader, INAT); HatemCheikhM'hamed (INRAT); Salah Ben Youssef (INRAT); Messaad Khamassi (INGC); Houcine Angar (INGC); Naima Ben Bahri (INGC); SamiaGargouri; Mohamed Annabi; SourourAbidi; Nadthira Ben Aissa; AnisBouselmi; Bassem MOUALHI; Hichem Ben Salem; Dorsaf HLEL; Hichem BELLAMINE; Aminabaccouri.

CANA/ ACIAR Project, Travelling Workshop, March-April, 2013

Morocco

Itinerary

24th March

13.00 Arrived Casablanca, Morocco Met by Oussama El Gharras (Project Coordinator, Morocco) and transferred to Hotel Golden Tulip Farah, Rabat

Overnight- Hotel Golden Tulip Farah, Rabat

25th March

0845 Departed hotel for INRA (Institut National de la Recherche Agronomique) Headquarters, Avenue de la Victoire, Rabat.

1030 Moved to ICARDA office in Rabat to sort out administrative matters relating to the teams visit.

1300 Lunch at roadside stop near Settât

1500 Meeting at INRA, Settât with Moroccan project team members

1700 Inspect forage trial, Settât

1800 Travel to Casablanca

Overnight- Hotel Golden Tulip Farah, Casablanca

26th March

0815 Departed Casablanca for OuedZem

1000 Arrived OuedZem Inspected two trial sites.

1330 Lunch at the Minister of Agriculture Extension Service Centre at OuedZem with extension officers and farmers.

1430 Meeting of travelling workshop team members with MOA extension officers and local farmers at the Extension Service Centre.

Overnight- Hotel Golden Tulip Farah, Casablanca

27th March

0830 Departed Casablanca

10.15 Arrive Ouled Said

Inspected trials at two sites

1200 Moroccan project discussions during lunch at roadside diner near Settât

1430 Most traveling workshop team members returned to Casablanca.

1500 B Mudge met with Hakim Boulal, 1800 Return to Casablanca

Overnight- Hotel Golden Tulip Farah, Casablanca

28th March

0800 Transfer to Mohamed 4 Airport, Casablanca for travel to Algiers

Key comments from the visit to the Moroccan platform

1. Given that this is the first year of the project, the Moroccan platform trials have been well established.

2. Effective weed control will be an on-going challenge for this platform. Weed control messages are complicated by the desire of farmers to retain the weedy fallow.
3. Farmers are seeking information on all aspects of weed control. This project may be able to assist by including specific weed control trials targeting information gaps.
4. The stated purpose of the on-farm research managed trials is to address the major research questions. It is likely that greater level of scientific rigour will be necessary (e.g. small plot replicated trials) to reach robust conclusions.
5. It would have been desirable to have spent more time in the field to observe the trials in greater detail. This may be possible on future visits by changing overnight accommodation location and by concentrating the visitation program on the OuedZem area.
6. The lack of availability of suitable direct drill machinery is a major constraint in this environment (as it is across all project platforms)

Summary of meetings and trial visits

March 25th

Meeting at INRA, Rabat

Pr. Mohamed Badraouri, Director of INRA expressed strong support for the Conservation Agriculture program, given that the promotion of techniques to improve water use efficiency was important to policy makers within the Moroccan government, and there was strong belief that CA could achieve this. Morocco was aiming to increase crop yields to reduce dependency on imports. The potential adverse effects of climate change meant that it was imperative to achieve best practice in all areas of crop production.

Also met with DrRachidDahan, Secretary General of INRA and DrRachidMrabet, Researcher. There is the need to identify constraints to the adoption of CA by Moroccan farmers. Several points were made:

- 1) Aim is for at least 50,000ha adoption of CA in each.
- 2) There is an expectation that WUE will improve under CA
- 3) They would like to see a briefing paper come out of this project promoting the value of CA to be presented to policy makers in the Government
- 4) One of the main challenge is to implement reliable crop rotations
- 5) Forage for animals remains a prime driver of outcomes for farmers

Meeting at INRA,Settat

Presentation was delivered by Moroccan Team Leader Oussama El Gharras on CANA achievements in 2012/13 in the ChaouiaQuordigha region.

There are number of other conservation agriculture projects which are running in conjunction with the ACIAR project, including Green Morocco Plan (PMV), an EU funded ACLIMAS project looking at crop rotations, crop establishment and N fertilisation in Durum and an ICARDA Enhancing Food Security project.

Khouribga and OuedZem were selected for this project as the area has had little contact with CA. These are two neighbourhoods but are contrasting communities. Good collaboration was expected from the local extension service.

Farmers to be involved were identified in September, 2012 with introductory workshops being completed with farmers and extension workers.

Soil sampling was undertaken and trial seeding occurred from 22/11/12 to mid-December.

There have been a number of difficulties in establishing the trials

- 1) Farmers expectations and perceptions about the contribution of CA to their businesses.
- 2) Co-occurrence of optimum time of sowing with local sheep feast, which delayed crop establishment
- 3) Rain then just after the celebrations further delayed sowing
- 4) It was difficult to get tractors when required
- 5) Availability of forage seed was poor
- 6) Team was under high work pressures

Lessons learnt

- 1) Need to focus on methods to achieve seed multiplication for rotation crops
- 2) Need to encourage more cooperation between extension workers, farmers and INRA researchers in planning activities
- 3) More supervision of farmer co-operators

Survey- M Boughlala reported 60 farmers have completed the initial survey- with a few more to go. It should be completed by the end of April, including data entry. Too early yet to draw implications regarding constraints to adoption or what is driving farmers adoption.

Participation and innovation was encouraged by inviting tractor and equipment companies along with input suppliers. None took up the invitation.

Regional Director M Kharbouche gave the MOA perspective. Similar to the message already given by PrBadraoui. Willing to work with researchers to encourage adoption of no-till.

Field site visits

INRA, Settat

Inspected forage trial with M El Koudrim. High levels of biomass achieved although composition in mixed cereal/ forage pea stand was heavily dominated by barley. Trial is looking at the effects of different levels of biomass removal. Harvesting of biomass at different levels will occur shortly.

26th March

BeniKhirane, OuedZem

Inspected two trial sites. These sites are primarily aimed at demonstrating techniques associated with crop establishment under no-till conditions.

Trials compared direct drilled wheat and forage with a normal farmer practice alongside. Direct drilled field trial also included a nitrogen rate trial.

Key points from these sites are:

- 1) Significant infestation of broadleaf weeds in both demonstration plot and farmers field. Demonstration wheat plot had been sprayed with metsulfuron and 2,4-D but later than would have been preferred due to concern about crop stage. Weed control had been below desirable standard. Later spraying and presence of residual weeds is likely to contribute to significant yield loss.
- 2) The direct drilled forage crop included a portion which had no pre-seeding application of glyphosate to control established weeds at seeding. This was a useful demonstration of the value and need for effective weed control prior to establishment of crops or pastures using minimal soil disturbance direct drill machinery.
- 3) Forage pea/ barley crop had a high proportion of peas in the observed biomass. Expected to have a good rotation effect.

- 4) It was generally noted that farmers' fields showed obvious nitrogen deficiency symptoms. It was not clear whether the nitrogen trial would provide useful information to add to knowledge on the management of N supply.
- 5) The weedy fallow is a feature of this farming system. Farmers value the weed growth as a supply of feed to their animals. They are concerned that chemical weeding may reduce opportunities for weed biomass production through a reduction in the seed bank. The value of an improved pasture phase using improved species (which would usually require annual sowing) still needs to be addressed by farmers.
- 6) Wheat seeding rates in farmers' fields are high, at about 150kg/Ha. Demonstration fields use lower rates.

Smaala

Inspected alley cropping site using atriplex inter-sown with forage mixture of peas and barley. Key points are:

- 1) Site was said to be waterlogged earlier in the year, but currently had a large biomass of mixed species including medics and vetch. However, weed species dominated.
- 2) Scrubs (planted in 2012) were overgrown with weed biomass. No attempt had been made to control weeds around scrubs.
- 3) The forage mixture had been sown without glyphosate application due to concern about possible spray drift onto scrubs.
- 4) As a result of the non-application of glyphosate and sowing into established weeds, the forage species were not performing well and had been largely competed out by the weed biomass.

Meeting of travelling workshop team members with MOA extension officers and local farmers at Extension Service Centre.

Key points from this meeting are:

- 1) Farmers indicated that they were quite accepting of the WUE benefits of no-till. They also believed the no-till system resulted in crops which were quicker to establish and usually were cheaper to establish.
- 2) They also saw erosion control benefits with no-till
- 3) The farmer's main concern expressed was the lack of suitable machinery to complete the sowing operation. The Syrian seeder had poor trash flow and blocked easily under modest residue levels while the Moroccan prototype was considered too heavy for the three point linkage tractors being used in the area.
- 4) One farmer expressed the view that one seeder would not be able to operate across all soil types and climatic conditions, and access to different seeders may be required.
- 5) Farmers expressed the need to improve knowledge, particularly in the area of herbicides for weed control.
- 6) Some brief examples of Australian involvement in no-till were given, including the need to have patience and persistence in adopting a no-till system.

27th March

Ouled Said (25 km west of Settat). Met with a project officer who is working on the ACLIMAS project. This is an EU project on adapting to climate change. Objectives are "To bring a durable improvement in the agricultural water management and a broader economic development in target

areas in the context of adaptation to climate change, increasing water scarcity, and desertification risk.”

Inspect demonstration field which has been direct drilled for 5 years.

Key points:

- 1) Uses demonstration trials of best practice. There are 10 sites in farmers’ fields. Testing crop rotations, seeding methods and nitrogen management.
- 2) Rotation trials are aimed at demonstrating the value of moving away from continuous wheat to a rotation which includes food and forage legumes and canola.
- 3) Fields are established using both the Moroccan and the Semeato(Brazilian) drill. The Semeato (a disc machine) have not been successful in stoney conditions
- 4) Limitations for food legumes include poor herbicide options for weed control and lack of suitable harvesting machinery resulting in high harvest losses. Branch broomrape also builds up quickly on food legume crops.
- 5) Brome grass can become a major weed problem in this environment under no-till.
- 6) The crops generally in this region are in good condition. Yields of the better wheat crops would expect to approach 3.5t/ha.

Inspected a rotation trial which included canola, wheat and forage options. Canola is performing well and may have a fit in Morocco. Issues are around availability of suitable varieties and access to a market.

Moroccan project discussions during lunch at roadside diner near Settat.

Opportunity for travelling workshop members to review Moroccan content of CANA project.

Key points:

- 1) There have been a number of challenges which have faced the project over its first year. Travelling workshop participants expressed appreciation of efforts of Moroccan team.
- 2) The project needs to work on improving farmer to farmer dissemination of information around no-till. Reaching out to young farmers will be important, using innovative technologies for information transfer.
- 3) There was a suggestion that the project could work on improving its visibility amongst local farmers. However, it was not clear how this could be done.
- 4) Getting a full understanding of the system, including a better understanding of the farmers position will be important in achieving project aims.

B Mudge met with Hakim Boulal, coordinator for North African region for International Plant Nutrition Institute (based at INRA, Settat). Hakim’s main goal is to improve WUE of the region through improved fertilizer management. He is available to work with the project to provide training courses on plant nutrition. His location at INRASettat means he is well placed to interface with the project.

Comments on addressing the 2012/13 Plan of Work, Morocco

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

60 farmers have completed the initial survey- with a few more to go. Should be completed by the end of April, including data entry. Too early yet to draw implications regarding constraints to adoption or what is driving farmers adoption.

(M Boughlala to provide Questionnaire to be appended to this report).

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

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

A total of 11 trials have been established in farmers' fields in theKhouribga and OuedZem districts to test various aspects of weed management and crop sequences.

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

Pre-seeding- Dr A Tanji has surveyed all fields before glyphosate application and taken weed counts. He has also taken soil samples from the 10 cm top soil and he is counting directly the germinated seeds in the green house under controlled conditions.

Post seeding- Fields were surveyed for any weeds that escaped to glyphosate, and appropriate herbicides then decided depending on the germinated seeds and the infestation. Information will be obtained on crop and weed biomass and yield effects of different weed levels. Unfortunately, all observed plots had at least a moderate weed infestation present, so implications of benefit of the absence of weeds may not be obtainable.

Proposed Action:-*Weeds control generally and specifically in no- till systems is clearly an area which needs considerable attention. Many of the fields observed under trial as well as those more generally in the landscape were carrying significant weed infestations which would carry substantial yield penalties. Priority should be given to meeting specific objectives and milestones under this activity.*

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

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

Three trials have been established to test rotation effects. Crop sequences used this year are wheat and forage mixture (peas and barley). The original intention was to include vetch and canola. Seed availability was the issue with vetch. Not clear as to why canola was not used, although may have been around suitable machinery and concern over availability of markets. It would be desirable to include further break crop options in future years.

Forage mixtures are performing well, with high legume content observed. Substantial break crop effects would be expected. Expect to expand break crop options in future years.

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

Team researcher, ZhorAbail, has a nitrogen trial incorporating three application rates at 3 farmers' sites. Due to problems at seeding, the phosphorous trial was not established this year.

Given the current good seasonal conditions currently being experienced in the area, these trials should provide valuable information on nitrogen nutrition requirements and economic benefit of N applications in this environment.

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

Trial 1. Monitoring soil health under conservative agriculture

Moroccan team researcher (from INRA) Brahim El Yousfi, is monitoring this activity. He has collected soil samples and laboratory work is being undertaken.

This project has undertaken to conduct spring surveys and comprehensive screening work to identify incidence and severity of root pathogens. It was unclear what stage this work had reached.

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

Soil samples from the researcher managed trials have been taken and analyzed for N, P and K. The intention is to follow up for future seasons and track the soil fertility after each crop. More work is also occurring on that aspect in the ACLIMAS project and results will be shared.

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

Base line data on soil physical properties has been collected from trial sites.

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

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

Mixed fodder crop of barley and forage peas (but heavily dominated by barley) has been established on the INRA experimental farm. Different fodder harvesting treatments to be applied leaving different residue levels. Effective economic appraisal of the value of retaining crop residue remains a challenge for this activity.

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

Scrubs (*Atriplex* sp.) were established on a field near OuedZem by the MOA extension services in 2012. This field is being used as demonstration field, with forage mixtures of barley, oats and triticale being sown between the scrubs.

Researchers were concerned about the potential for spray drift affecting the scrubs and the inter-row sowing treatments were established without using any pre-sowing glyphosate treatment. Scrubs are now largely overgrown with weed biomass. Establishment of improved fodder species has also been poor due to competition with weeds. Also, site was very wet early in the season.

Proposed Action: *This trial has an impressive biomass growth, but has been compromised by limitations mentioned above. Limited value from an extension viewpoint. Would be desirable to identify improved methodology.*

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

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

Moroccan Scientists Mobility to Australia

Proposed Action:*A El Brahli to visit Australia in late May, early June to inspect seeding processes along with Australian experiences with farmer managed direct drill organizational structures and methodology.*

Algeria

Itinerary

28th March – 2pm arrive at Algiers

3 to 4pm - meeting with Dr Omar Zaghouane, Director General, ITGC

Overnight Ibis Airport Hotel

29th March – 7am Leave Algiers

11am to 12.30pm meeting at INRA, Setif with project staff

Lunch at El Mokhtar Hotel

2.30 to 6.30pm visit field sites at OuledBoutera and Guellal and machinery engineer at....

Overnight at El Mokhtar Hotel

30th March

8.30am - visit trials at El Hassi, farm of Mansouri El Khier

9.30am – visit trials at Ourissia, farm of Tabhirt El Hadi

11.30am - visit trials at Ain Arnat, Koli farm

1 to 2pm – lunch

2.30 – visit trials at farm Khababa

4pm – visit trials at Boukari farm

5.30pm – return to Algiers

31st March

8.30am to 10am – meeting with ITGC project staff, chaired by Omar Zaghouane.

10.30 to 12.30am – visit ITGC field station

1 to 2pm – lunch at ITGC

4pm – to Tunisia

Key comments from the visit to the Algerian platform

1. The trials were well done, especially with the short planning time and the need to sow into other than ideal conditions in the first year (such as wheat into wheat stubble). Presumably as a result of the short planning time some inputs were late in arriving, such as lentil seed, atriplex seedlings and some herbicides.

The presentation at each site was very good with a succinct trial summary and a display of assessments so far, such as soil characteristics, crop establishment and weed density measurements.

One of the highlights at each trial site was speaking with local farmers about their farming experiences, especially their attitude to conservation agriculture.

2. Seeder comparisons

There appeared little difference in crop establishment between the two seeder types. Plant counts were approx. 80% for both cases. There was no instance of seed being sown too deep, but rather too shallow in some cases. This may be due to hard soil when seeding.

Many of the fields in Algeria appear very uneven following a long history of deep ploughing. Seeding machinery with some contour following capacity along with the use of press-wheels for furrow closure could be beneficial. The uneven surface may also affect harvesting of the lentils if done by machine.

3. Weed management

Although weed severities were generally less in crops in this region than in Morocco they still appear to be a significant constraint on increasing water use efficiency. Grasses and broadleaf weeds were common in most trials, in some cases even where herbicides had been used.

Herbicide test strips (done with a small boom) with different herbicides, rates, mixtures and timings would help work out which are the best treatments to use for specific weed and crop situations. These would be beneficial to farmers and extension officers as well as to the Algerian project team. For example, the use of trifluralin or pendamethalin should be assessed in no-till and conventional systems, especially for the control of polygonum and some grasses, especially in legume crops.

Note, **the herbicide Zoom should not be used (in cereals) the year before sowing lentils because the residual component** (triasulfuron) could damage the lentils severely.

In some cases weed control with relatively high rates of glyphosate (over 2L/ha) appeared marginal. Suggestions to improve the efficacy of glyphosate are to:

1). Check the carbonate level of the water used. If high (more than 250ppm) use other water or add ammonium sulphate (8kg/1000L) to the water in the spray tank before adding the glyphosate.

2). Reduce water rates from the current 300L/ha to approx. 100L/ha by changing spray nozzles, spray pressure &/or spraying speed.

Lower drift jets (such as low pressure air induction jets) should be fitted to reduce spray drift, for example in the forage trials.

In the event of an early seasonal break (e.g. in September) it will also be important that the project adopt best practice in controlling early weed germination prior to seeding in, say, November. This would usually involve an early spray of glyphosate to prevent early germinating weeds from developing into large weeds which will be difficult to control prior to seeding.

Weeds researchers mentioned herbicide resistance for some weeds. This needs to be clarified as it may be an inherent tolerance to a specific herbicide (such as glyphosate on *Malva* spp.) rather than a genetic shift due to herbicide use.

4. Crop Sequencing

Different crops (including forage alternatives) are being tested presumably as an alternative to a weedy winter fallow followed by the traditional spring cultivation. It would be useful to include the traditional fallowing method as a control to compare rotational benefits. At least, this may then allow the project to identify what benefits (if any) are coming from the traditional fallow- e.g. moisture retention, weed control, increased mineralisation. This knowledge will be important in understanding the constraints to grower adoption of the new technologies.

5. Crop nutrition

Many wheat crops in trials and in farmers' fields appeared low in nitrogen. There is an opportunity to assess crop responses to nitrogen by applying known rates of nitrogen fertiliser (by hand) to small plots within the trials.

Nitrogen and phosphorus fertiliser rates for wheat crops did not seem to relate to soil reserves and likely crop demand. They were either multiples of a quintal/ha or, in the case of some farmers, none at all. There was also no evidence of any leaf tissue testing for crop nutrient status to assess if any nutrients were deficient.

6. Soil quality

There needs to be an assessment of the rooting depth of the main crops grown to better interpret soil water measurements.

There was no listing of sodium in soil analyses. We need to find out if surface crusting is due to high sodium content of just too many years of cultivation and removal of residues.

7. Crop residues and livestock feeding

Obtaining adequate feed for livestock remains a high priority for local farmers. The opinion was expressed by local researchers that there are probably too many livestock being carried but this situation is unlikely to change. Therefore, the need is to increase biomass production.

Traditionally, livestock have been run on a weedy fallow in winter which is subsequently ploughed in spring. Advocacy of alternative crop rotations needs to address the forage needs of the animals.

The forage crops in the alley farming areas were very impressive with a good, even mixture of peas and cereals. However, the late planting of the atriplex (due to late arrival of the seedlings) may mean that the establishment will be less than if planted earlier.

8. Training visits to Australia

Proposed Action: It is recommended that Mr Laouar Abdelmalek (project coordinator at Setif), as well as Mr Djamel Houassine (the Algerian project coordinator) visits Australia this year to study CA techniques. These include crop agronomy, trial design and evaluation and crop management generally. Based on our observations in Algeria there would be a particular emphasis on assessing our systems of weed management and crop nutrition to see how they could apply in Algeria.

Summary of meetings and trial visits

March 28th

Meeting with Dr Omar Zaghouane, Director General, ITGC

Omar emphasised the importance of the agricultural industry to Algeria.

They need to increase crop and forage production to reduce imports of these commodities. Cereal production is 5m tonnes, 70% of the national requirement.

Of the cereals grown durum is 50% of production followed by barley, then bread wheat.

Subsidies for grain growers include price support (durum A\$640/t, bread wheat \$500/t, barley \$360/t), fertiliser and seed. There are also generous subsidies for the purchase of seeders, tractors and harvesters.

Forage is also imported to meet the shortfall for the 24m sheep and 8.5m cattle in Algeria.

He also emphasised that the largest percentage of farmers have small farms sizes (less than 10ha).

There is a strong association with land ownership and so very little is sold to others.

It seems then that the main incentive for farmers to change to conservation agriculture would be for greater returns (due to the high grain prices) from higher yields rather than from savings of inputs (which are relatively cheap) or time savings from no longer cultivating before seeding (because most farm areas are still small).

March 29th

Meeting at INRA, Setif, with project staff

32 attended, including the Director Sersoub Djamel

These included ITGC and University staff and farmers. This was a very useful meeting to meet those associated with the project and hear about the region and the project.

The Setif region has 361,000ha of farming land, of which 5% is irrigated. The area of direct drilling has increased from 2ha in 2007 to 813 ha in 2012.

Grazing land makes up 11% of the total. There are 484,000 sheep and 120,000 cattle in the region. It is the most important region in Algeria for dairy cattle.

Recent monthly rainfall totals at Setif are:

September 2012	16mm
October 2012	27mm

November 2012	86mm
December 2012	11mm
January 2013	91mm
February 2013	62mm
March 2013	43mm
Cumulative	336 mm

Elevation of the trial sites ranged from 559m to 1214m. Soil types ranged from shallow calcareous soils to deep clays.

All 25 trials (at a total of 12 farms) in the six programs have been sown as planned. Seeding dates were in mid-November, with the second time of seeding in mid-December. Post emergent nitrogen fertiliser had been applied only recently and the later broadleaf herbicide for cereals would be applied in the near future.

Issues mentioned with some trials include

- very late planting of atriplex (in March rather than earlier) due to late arrival of seedlings and to unsuitable weather conditions
- lack of availability of selective grass herbicide (Fusilade) for control of grasses in lentils in the crop and grazing rotation trials.

We also inspected the farm machinery at the research station available for the trials. This included Syrian and Semeato drills and a Hege plot harvester. This harvester was used at the research station and not for other field trials, apparently because of lack of suitable transport. There was no hydraulic soil sampler for taking cores to depth (eg 1m).

Field site visits

We visited eight of the twelve trial sites in the Setif region.

Presentations at field sites were very good. Trial details were summarised on a large poster display and some plots were labelled. There was a succinct verbal presentation of the trial treatments and some preliminary results. There was also ample time for questions and discussion and to look at the plots.

Also the cooperating farmer was present at each site to talk about his experiences in CA farming.

Site 1 – Farm of LaidiDjamel, OuledBoutera

A total of 48 people attended this site inspection.

Crop rotations and weed control

Crop growth was impressive (due to early seeding and plenty of fertiliser (100kg/ha of phosphate fertiliser and 100kg/ha of urea).

The uneven surface may affect harvesting of the lentils. There was no roller available locally for this site to level the soil after seeding the lentils. Establishment of lentils was also good and they had plenty of nodules. There were questions about what growth stages of lentils are safe for rolling (to push in stones and level the surface for harvesting). In our experience it is no later than the 8 node stage.

Weeds were common in both crops and pastures. These included French geranium, a Diplotaxis (mustard) species, and a Fumaria (fumitory) spp. The herbicides available appear to be not very effective against some of these problem weeds.

Many of these weeds emerge after crop emergence and so are not controlled by the glyphosate applied pre-sowing.

There is the risk of carry-over of triasulfuron (in Zoom herbicide), used in the barley, affecting lentils the following year.

Site 2 – Sagrodev farm, Guellal

Soil characteristics

There was a soil pit (to 1m) at this site. There was a clear difference in soil colour (due to higher carbonate) at 30cm. Crop roots were mostly in this upper zone. There were some roots at greater depth.

Soil data at site 2:

	<u>Top horizon (0 to 33cm)</u>	<u>Second horizon (33 to 60cm)</u>
Organic matter (org C)	1.9	1.2
pH	8.7	7.7
Total carbonate	34%	46%
P (ppm)	3.3	1.1
% clay	32	44

Crop residues and grazing

Wheat emergence was reduced somewhat by surface crusting and uneven soil surface, leading to variable seed placement) at seeding. This crusting appears to be a result of many years of cultivation rather than due to salinity. Lentil establishment was good.

Seeder comparison

Crop emergence (84%) was similar for both seeders.

As in other trials there was some unevenness along rows possibly due to surface crusting and some seeds being sown deeper or possibly too shallow. After several years of no-till, improvements in soil structure and a more even surface are likely to improve crop emergence and establishment. Fitting press wheels on the Syrian seeder is also likely to improve crop emergence.

Forage crops and alley farming

The forage plots were well established with a good, relatively even mix of barley and peas. The atriplex was late sown due to late arrival of the seed.

March 30th

Site 3 -, Farm of Mansouri El Khier, El Hassi

Crop rotations and weed control

Soil type: stoney, shallow & calcareous. Surface soil organic matter was low - 1.03%. The pH was 8.0, and so not crop limiting.

Wheat was well established (81% emergence) and at tillering stage but appeared nitrogen deficient. There were also a lot of weeds, including *Dauuscarota* (carrot weed), *polygonum* (wireweed), *veronica*, *fumaria* and *medic*.

Site 4 - Tabhirt El Hadi, Ourissia

Seeding dates and weed control

There were plenty of weeds here to show treatment effects. There was a slight reduction in weed numbers where seeding was delayed and glyphosate applied pre-sowing, but it appeared that most weeds emerged after seeding. There was a discussion here with farmers about spraying the broad leaf herbicide at an earlier growth stage, e.g. by combining with the grass herbicide, to improve crop grain yield.

Crop rotations and weed control

Wheat was at the 4 leaf stage and appeared low in nitrogen. Lentils were growing well (for this growing environment) and the root systems had plenty of nodules. When questioned about inoculating legumes the farmer explained that he spread soil from where he had grown legumes previously. Seed for these trials was also inoculated.

Daucus, *polygonum*, *medic* and *veronica* were common weeds in these trials.

Site 5 - Koli farm, Ain Arnat Seeding dates & weed control

A good grass weed site, especially with Italian ryegrass (*Lolium multiflorum*), bromus, as well as some broadleaf weeds (polygonum and veronica).

The two times of sowing of the wheat were 19th November and 18th December. A delay in sowing, and a spray of glyphosate pre-sowing, reduced grass and brassica weed infestations but had less impact on other weeds, such as polygonum.

Crop rotations and weed control

There were a lot of weeds in this trial. Gesagard appears to be not very effective for broadleaf weed control in lentils. They are still waiting for the grass herbicide (Fusilade) to arrive to treat the grasses in the lentils.

General Comment

Interesting comments from the farmer co-operator who was adamant that he would not plough his fields into the future, even though at this stage he had not yet had harvest results from the no-tilled fields. He was impressed with the crop establishment under no-till and he saw the main advantage as **saving up to 2 weeks ploughing time**.

Site 6 - Khababa farm

There were five trials at this site.

This was a deep clay soil, adjacent to a river, and with much higher yield potential than the other sites.

The soil analysis showed a much less organic carbon in the top 60cm (1.0%) compared with the next 80cm (2.6%), presumably due to a very long period of cultivation and removal of residues. pH, clay and carbonate contents were similar for each of the soil profile fractions (0 to 60, 60 to 140 and 140 to 170cm).

Seeder comparison

This was one of the few times we saw residue blockage problems at seeding and a reduced wheat emergence (to 60% instead of the usual 80%).

Crop rotations and weed control

Galium (bedstraw) was a common weed in trials at this site, as it was at some other sites.

Seeding dates and weed control

A delay in seeding from 23rd November to 15th December and using glyphosate pre-seeding appears to have little effect on the broad leaf weeds in this trial.

Forage crops and alley farming

There was a good establishment and mix of peas and cereal.

The atriplex was sown later than planned due to late arrival of seedlings.

Herbicide was applied only to the centre area of the inter-sown wheat because of the risk of herbicide spray drift onto the atriplex seedlings.

Crop residues and grazing

There was a discussion here about how best to set up the grazing treatments.

Site 7 - Boukari farm

This site had lighter soil with some limestone rubble. It also had established alleys of pine trees. Wheat grain yields were in the range of 0.5 to 1.0t/ha due to low rainfall (250mm) but up to 5t/ha with irrigation.

As at Khababa farm the organic matter in the surface (33cm) soil was much lower (1.1%) than in the next fraction (30 to 67cm) (1.6%), indicating depletion of organic matter, presumably due to excessive cultivation and removal of residues over a long period.

As at some other sites, weeds such as bedstraw (*Galium*) and polygonum were common in the trials.

Seeder comparison

Wheat was at tillering growth stage. Seed was sown very shallow and there were gaps of up to 0.5m of missing plants along rows, presumably due to the shallow seeding. Establishment and crop vigour appeared slightly better with the Semeato than the Syrian seeder.

Crop residues and grazing

This was sown two weeks later than they planned due to the late arrival of the lentil seed.

Forage crops and alley farming

There were lots of bedstraw (*Galium*) and polygonum in this trial. In this case it would add to the forage biomass and grazing after cutting.

There was also a demonstration of direct drill seeder at this site. This had 16 rigid tynes fitted with narrow points. The details of this seeder were not revealed, other than it was “assembled in Algeria”.

Comments on addressing the 2012/13 Plan of Work, Algeria

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

Socio-economic survey initially commenced by testing the questionnaire on some farmers' from ATU association.

The main survey is now in progress and forty farmers have been already questioned.

The majority of farmers sampled have an area less than 20 Ha

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

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

Activity 2.2.1. Study the dynamics of emergence and growth of weed populations for developing an integrated management of weeds in CA systems

The weed trials were well done and data was presented at each weed trial of the weed counts. These were assessed at fixed point quadrats in each plot.

Proposed Action:*Herbicide test strips, using different timings, rates and mixtures would be a useful addition to these trials both for additional information on weed control in these conditions and as demonstrations for farmers and extension officers.*

The availability of practical and cheap boom sprays, and good extension information and training on weed management, including herbicide spraying, appear to be worthwhile objectives for improving weed control and crop yields.

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

Activity 2.2.2.1 To test rotations to improve soil fertility, weed management, ensure permanent soil cover and to provide new resources to operate while reducing fallow.

Trials have been sown at four sites, as planned.

Proposed Action:*Canola is listed in the Plan of Work but has not been included in these trials, apparently due to lack of availability of seed. This needs to be followed-up to see if it should be included in future trials, and if so, how seed can be obtained.*

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

A lot of detailed measurements have been done, especially in relation to soil quality. As at the other platforms, an assessment of crop rooting depth for the range of soil types would be useful, especially to calculate crop water use efficiency.

There were details of any assessments of root or foliar pathogens in these trials or in CA farming generally.

Proposed Action:*When assessing soil profiles estimates of rooting depth of the range of crops grown should be made, if not being done already.*

Proposed Action:*Follow-up with Dr. Nleddine Ravog at the University in Setif, to find out what work has and is being done on root and foliar pathogens in CA farming in this region. The DNA root pathogen tests should be considered here, after a review of the pathogen testing program in Tunisia.*

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

Activity 2.3.1. To study the effect of wheat crop residue management on soil cover, animal performance and soil fertility

Five trials of wheat/lentil rotations have been established. There was some discussion about how to set up the grazing treatments (as in Tunisia).

Proposed Action:*Follow-up with research staff about the implementation of the grazing treatments.*

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

All sites have been sown and have a good mix of cereal and peas. The atriplex has been only recently planted due to late arrival of the seedlings.

Proposed Action:*The atriplex will need to be monitored, and watered if necessary, to ensure seedling survival during the coming summer.*

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

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

Moroccan Scientists Mobility to Australia

Proposed Action:*It is recommended that Mr Laouar Abdelmalek (project coordinator at Setif), as well as Mr Djamel Houassine (the Algerian project coordinator) visits Australia this year to study CA techniques. These include crop agronomy, trial design and evaluation and crop management generally. Based on our observations in Algeria there would be a particular emphasis on assessing our systems of weed management and crop nutrition to see how they could apply in Algeria.*

Tunisia

Itinerary

1st April – 7am depart Tunisia

Visiting four trial sites in the Fernano district
Overnight at Nour El Ain Hotel, Ain Draham

2nd April

Bou Salem - Visit INGC station, Kaudat
11am to 4.30pm – INGC Research Centre, Marja
- Inspection of field trial equipment
- Presentation of project reports
Return to Tunis, Le Consul Hotel

3rd April

9 - 10am – meet with President and other staff at IRESA
2.30 – 5.30pm Water use efficiency workshop, Le Consul Hotel, Tunis
Overnight, Le Consul Hotel

4th April

8.30am to 12.30pm – continuation of Water use efficiency workshop, including scoping priority issues in crop production across the three countries
1.30 to 3.30 pm – meeting with Mohammad El Mourid, Icarda, North African Regional Coordinator

Summary of the Fernana district

This is an undulating, high rainfall (820mm) region, prone to water erosion. Rainfall from December to February was exceptionally heavy this year – over 500mm in total. This reduced crop establishment and also caused a delay in application of some treatments (especially nitrogen and herbicides) to trials.

There are approx. 4,200 farms here, with 52% less than 10ha and 30% between 10 and 30ha. Cropping (with cereals and legumes) comprises 76% of the area. Average cereal grain yields are only 1.2t/ha. The estimated livestock numbers are 14,200 sheep, 7,040 goats and 8,000 cattle. Hence, this district has high yield potential as well as a high soil erosion risk. It also has the challenge of improving the practices of farmers with many small farms and little or no farming machinery. For example, there were only four boom sprays available in this region.

Key comments from the visit to the Tunisian Platform

1. Considering the short planning time the trials have been generally done well. There were some instances where seeding appeared to be later than farmers crops nearby, for example for beans in the weed trials. At several sites crops were thinned out by excessive water and possibly hail. It is expected that in future years, with improvements in soil structure with direct drilling, that water logging will be less.
Grower considerations have also impacted on the trials, including paddock size, and crop treatments (such as weed control). In one case a trial site was lost because it was ploughed by the farmer.
2. Crop establishment and vigour was less than ideal as a result of heavy rainfall after seeding. There were also indications that the crop vigour would have been better with earlier sowing.
3. As in other platforms the nitrogen fertiliser decision did not seem to be based on likely crop requirements, but rather standard applications. Small plot trials could be used to investigate crop responses to a range of rates of nitrogen. Additional soil and crop measurements (of nitrogen) should be done where doing these response trials.

4. Weeds were less abundant than in Morocco and Algeria, but were still considered to be reducing crop yield in some cases. Also technical knowledge of herbicides could be improved. The effectiveness of pendamethalin is likely to be better if applied before sowing and then incorporated by seeding, rather than being applied post sowing pre-emergence, as is the case in the trials here. The comment that trifluralin may not work in direct drilling systems needs to be tested in trials. In the Australian experience, using knife points, trifluralin is very effective both in terms of crop safety and weed control, except for more weeds along the crop row. This is because the herbicide is thrown out of the row by the knife points into the inter-row. There was also some uncertainty about the future availability of trifluralin in Tunisia, which needs to be clarified.
5. Canola has not been included in these trials, even though it is listed in some plans. Comments made about this were that it is not grown commercially in this region and that there was no market for the harvested seed.
6. All soil samples (up to 60cm deep) are taken with a hand auger. There is a limit to how many samples can be done using this system, possibly compromising data collection. Sampling this way can also introduce errors (of soil mixing in the profile) when sampling profiles separately.
7. There was a widespread issue of plant death in chickpeas through a lot of this region. Normal vigorous plants turn yellow and eventually die. So far diagnostic tests have not identified the primary cause.
8. As a general comment, trial plots could be marked out more clearly, and with weather proof labels with a treatment summary, to encourage visits to the trial sites and promote the agencies involved.

Summary of trial site visits

April 1st

Approx. 30 people toured the trial sites, including project staff and local farmers.

Site 1

Weed management

This trial tested four different herbicide treatments in faba beans sown at two row spacings. As a result of the heavy rainfall and water logging the faba bean stands were relatively sparse and stunted. Also weed numbers in this trial were not very high for good comparisons between treatments. Weeds included Galium (bedstraw), polygonum (wireweed) brassicas and convovulus. The efficacy of pendamethalin herbicide may well be improved by applying it pre-sowing rather than post sowing pre-emergence, as is the case in these trials.

Seeder comparison

Establishment was only approx. 50% due to wet conditions after seeding. Crop establishment was better with the Semeato seeder than the Syrian seeder.

A soil pit at this site showed significant soil compaction near the surface. This would have restricted water infiltration and so increased the soil run-off. It would also have restricted the root systems of crops reducing crop growth and yields.

A local farmer (AbdrabbaAdnen) discussed his experiences with his CA program. He is in his 14th year of direct drilling and listed the main benefits as improved crop production through better soil condition and reduced water run-off and erosion. The high cost of the direct drill machinery is regarded as a constraint to adoption.

Another local farmer mentioned the value of networks of farmers and others for learning more about conservation agriculture. He also planned to form a syndicate of farmers to purchase a direct drill seeder. Much of the interest and information for farmers on direct drilling seemed to come from neighbours and relatives.

Site 2

Crop sequences

This trial compared durum wheat after wheat, beans or vetch.

Again this had obvious water logging issues (poor emergence and crop vigour) from excessive rainfall. No vetch germinated at all. Reason for this was not clear, but presumably due to the wet conditions as some vetch germinated at the other sites where the same seed batch was used.

Residue management trial

The main discussion at the residue management trial was about how best to fence off plots and manage the grazing so it was similar to farmer practice.

Site 3

The farmer (Jamel Ghazouani) at this site farms 18ha and has 15 sheep and 8 cows. The 18ha includes 8ha of irrigation for the production of tomatoes and melons. He does not own a tractor, seeder, sprayer or harvester. All machinery operations are done using contractors. Approx. land values are A\$3,000/ha for dryland and A\$15,000/ha irrigated.

Crop sequences

This site was on the top of a rise but there were still signs of water logging recently. There was significant take-all disease in the durum – because this site had wheat the previous year. In future years in the rotation trial beans will precede the durum and so the severity of take-all is expected to be much less.

Faba beans in the trial were shorter and less vigorous than a nearby crop sown earlier and had signs of root disease. This was presumably due to being later sown as well as the water logging and recent hail.

The vetch stand was thin here as a result of poor germination and establishment.

There was also a residue management trial at this site

Site 4

Forage and alley farming trial

This was a very good trial. The mix of 80% vetch and 20% barley was the result of previous studies on optimum mix ratios. Lucerne was to be sown into mown triticale shortly and the spineless cactus was to be planted in the alleys in May.

Weed management trial

This was a good trial with even establishment of the faba beans and plenty of weeds (including Sinapsis (mustard), Raphanus (radish), Lolium (ryegrass) and Daucus (carrot weed).

April 2nd

Site 5 ITGC experimental station, Kaudat

The experimental station is 32ha in size and has irrigation facilities. Average annual rainfall is 556 mm- over the past 10 years and has ranged from 308 to 768mm. The majority of the crops are direct drilled. Crop establishment, vigour and management were outstanding.

Trials included a long term (11 year) no-till trial. Other crops grown were sugar beet, maize, Haricot beans, lucerne and phalaris (grown for seed). Some of these (maize and beans) were double cropped with other crops in the one year.

Crops at this research station, including chickpeas, had very few weeds. These had been treated with trifluralin and simazine. Snails at harvest were mentioned as an issue, although the numbers of snails on crop stalks (at crop heading) appeared low by South Australian standards!

The long term rotation trial included a comparison between direct drilling and conventional (discing and ploughing). Rotations included durum wheat with barley, wheat or fenugreek as well as oats or barley with lucerne. The severity of fusarium crown rot is greater in the continuous wheat plots than where wheat is after other pulses.

There has not been any noticeable change in weed populations with direct drilling compared with ploughing.

There were other trials at this site linked with programs in INRA, Toulouse, France. These included forage mixtures with legumes, and barley line mixtures to suppress foliar diseases. There was also a study by a PhD student (by WalaJlassi) on water use in cropping rotations.

ITGC research station, Marja

This included a tour of research station field facilities and presentations of trial reports.

The INGC research station at Marja employs 24 researchers and approx. 80 other staff.

Programs include variety evaluation, crop protection, cultural practices, economics, communication and extension. Disease management programs include resistance screening and assessing fungicide efficacy. Weed management includes surveying weed incidence and assessing herbicide efficacy.

Funding is from a grower contribution (of 4.30DT/tonne) and the annual budget is approx. A\$3m. Details of work on all aspects of the project so far were presented.

April 3rd

Travel to the headquarters of IRESA (Institute of Agricultural Research and Higher Education). Met with Director, Prof Mohamed Aziz Darghouth. IRESA has a total of 23 groups, 11 of which are involved with higher education (total of 5500 students including 700 post graduate) and 12 are research orientated (total of 800 scientific personnel).

Discussed

- 1) Importance of linkages with farmers. Need to have efficient linkages between researchers and farmers, but also farmer to farmer transfer of information is important.
- 2) Use of farmer demonstration fields was considered an efficient way of linking to basic research.
- 3) Importance of professionalising farmers to improve agronomic practices.

Comments on addressing the 2012/13 Plan of Work, Tunisia

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

The statistics of the Fernana region have been compiled (see above notes) and the survey is progressing well. So far there have been 120 interviews out of a planned total of 150. To obtain more information about machinery use the survey categories have been expanded to now include some properties between 10 and 20ha and more than 20ha.

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

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

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

Three of the four planned weed trials in faba beans have been treated. The fourth was ploughed by the farmer. One site were well established with a good even density of weeds, but the other two had

thinner crops and fewer weeds, presumably due to excessive rainfall and water logging after seeding.

The main weeds researcher, ThourayaSouissi, expressed interest in visiting Australia mid-2014 to further her knowledge on weed biology and control, and assessing and managing herbicide resistant weeds.

Although weed severities were generally less in crops in this region than in Morocco and Algeria, weeds still appear to be a significant constraint on increasing water use efficiency in this region. The availability of practical and cheap boom sprays, and good extension information and training on weed management, including herbicide spraying, appear to be worthwhile objectives for improving weed control and crop yields.

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

Activity 2.2.2.1 To test the effect of wheat, beans or hairy vetch in rotation with durum on soil fertility, weeds and soil pathogens

Four trials have been established to test rotation effects although at two trial sites there was almost no establishment of the vetch. Where establishment was normal here was a very good mix of good vetch and triticale. The vetch species used (hairy vetch) seems to be different to that used by farmers (common vetch).

Proposed Action: *The vetch needs to be monitored more closely in future years to see if any poor establishment is due to a lack of viable seed, seed rotting or seedling death. Also, if hairy vetch is to be the preferred type for forage in this region there will need to be a seed production program, if not already established.*

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

A lot of detailed measurements have been done, especially in relation to soil quality. Water infiltration into the clay soils appears to be impeded by compacted layers.

The root disease pathology program, by Samia Gargouri, is also very detailed. This year she will be testing the DNA root pathogen system (from SARDI, South Australia) to quantify root pathogen of crops.

Proposed Action: *Treatments to reduce soil compaction, such as ripping, should be considered.*

When assessing soil profiles estimates of rooting depth of the range of crops grown should be made, if not being done already.

The DNA root pathogen tests should be considered for the other platforms as well, after a review of the pathogen sampling program in Tunisian.

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

Activity 2.3.1. To study the effect of wheat crop residue management on soil cover, animal performance and soil fertility

Four sites have been set up using a wheat/ bean rotation. Grazing treatments have been reduced from four to three for practical reasons.

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

This program is testing and considering a wider range of options. These include oats (in place of triticale and barley), and sulla (*Hedysarum*) as an alternative legume.

Cactus will be planted in May.

Refer to comments above (2.2.2.1) about the availability of vetch seed for farmers.

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

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

Moroccan Scientists Mobility to Australia

1. **Proposed Action:** *Mohammed Jadlaoui INGC, Marja, will be visiting the Agricultural Machinery Research and Design Centre (AMRDC) in South Australia in July 2013.*
2. *Slim Arfaoui, the manager of the Kaudat experimental station, will be attending a 4 week course at the University of Southern Queensland in September, 2013.*

Water Use Efficiency workshop, Tunis.

Participants

- A Mayfield, B Mudge (Rural Solutions SA)
- P Wall (ACIAR)
- Said Djamila, Houassine Djamel (Algeria)
- Oassama El Gharras, Mohamed ElKoudrim (Morocco)
- Boubaker Thabet, Walid Brahmi, Wala Jlassi, Maaroufi Hayet, Halim Ben Haj Salah, Thouraya Souissi, Mohamed Jadlaouri, Issan Nouijj, Hatem Cheikh Mahomed, Houcine Angar, Mohamed Ali Hannachi, Anis Bouselmi (Tunisia)

Areas covered:

- 1) Benchmarking WUE using French/Schulz
- 2) Historical situation of crop yield growth in Australia
- 3) Frameworks to assess WUE in rain fed systems
- 4) Historical WUE in Tunisia
- 5) Climate and crop drivers of WUE

Methodology was presented on ways to adopt a consistent approach to measuring Water Use Efficiency across the project. Full details are contained in resource material provided to participants (see below).

A significant achievement for this project would be to get some estimate of the size of the yield gap which currently exists in the North African cropping systems. To achieve this will require the calculation of Water Use Efficiency at research sites.

The best method to measure WUE includes the assessment of plant available soil water at seeding and harvest. However, this is difficult to achieve without the use of a hydraulic soil coring unit. It appears unlikely that these units will be widely available to this project. Therefore, it may be an unrealistic expectation that meaningful assessments of WUE can be obtained within this project.

Proposed Action:*It is suggested that the possibility of including an estimate of WUE being achieved at research sites used in this project be discussed at the planning meeting to be held in Algeria in September, 2013.*

Participants were then separated into working groups to identify the areas of management influence that they felt would be most likely to lead to improvements in Water Use Efficiency. The framework in Figure 1 was used as a model.

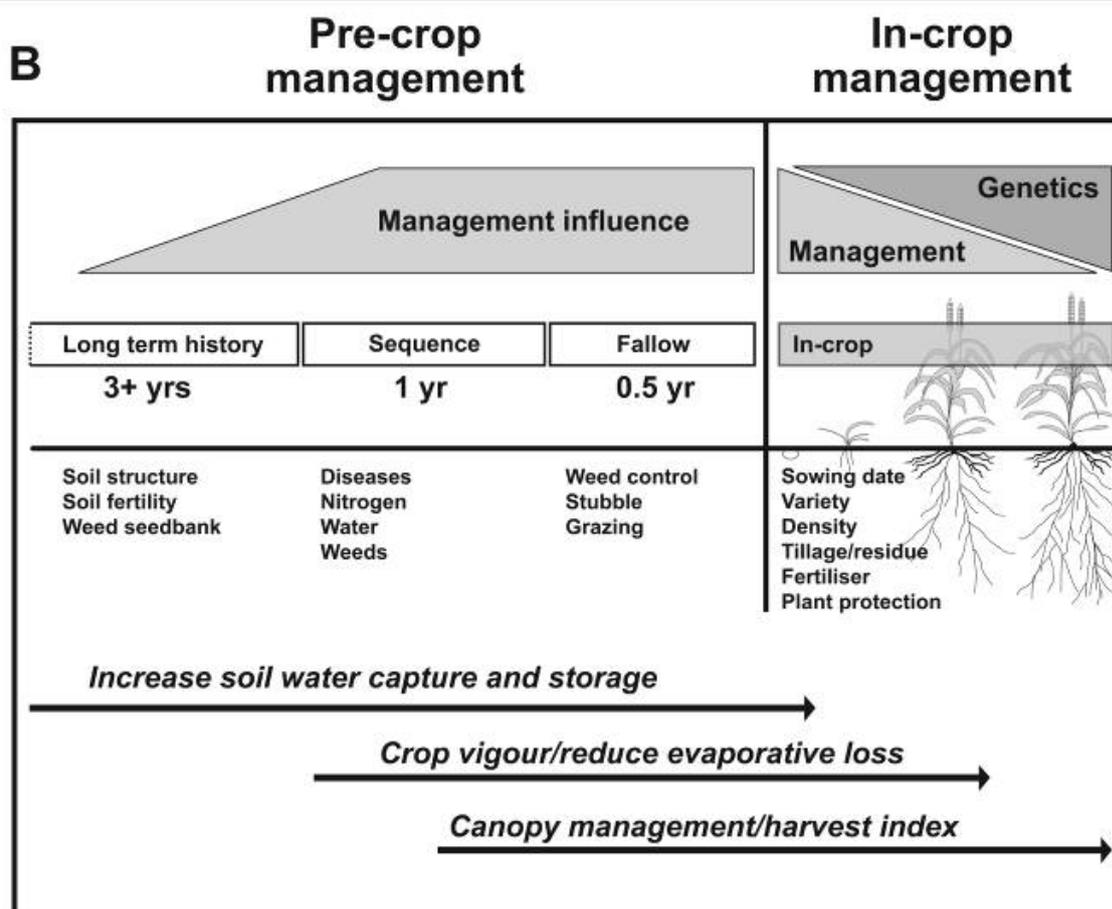


Figure 1. Framework for identifying areas for improvement in Water Use Efficiency

Table 1 Group assessment of potential for improvement in Water Use Efficiency (%) in relevant areas of management influence

Team location	Pre-Crop Management			In-Crop Management	
	3+ years	1 year	0.5 years	Management	Genetics
Tunisia	30	10	5	30	25
Tunisia	25	20	0	45	10
Morocco	14	40	1	30	15
Tunisia	25	25	10	30	10
Algeria	25	20	15	20	20
Overall Ranking	2	3	5	1	4

Generally, the group considered that the best potential for improving WUE and therefore crop yields lay in improving in-crop management. Pre-crop management, largely around improved crop rotations was also seen as important. On the other hand, improved fallow management was not considered likely to lead to significant gains.

An interactive session was then conducted to identify potential areas for improvement in crop management in the North Africa region.

Issues which could be addressed:

Weeds

- 1) Application technology- considerable room for improvement. This would include addressing constraints to spray equipment such as incorrect nozzles causing spray drift
- 2) Improved information on herbicide efficacy including herbicide mixtures- identify knowledge gaps and implement trials to overcome
- 3) Extension of herbicide information to farmers e.g. using herbicide evaluation strips for farmer demonstration
- 4) Effect of weeds on crop yield loss- including timing of weed removal

- 5) Availability and cost of herbicides
- 6) Potential to develop a herbicide and weed control chart for distribution to farmers

Nutrition

- 1) Most farmers are not using soil testing at the moment to provide guidance on fertiliser decisions. Current recommendations are primarily prescriptive.
- 2) Some logistical concerns were expressed about farmers collecting soil samples
- 3) Thresholds for interpreting soil sample results are not necessarily in place
- 4) Nitrogen decision making can be based on plant health indicators such as colour. Current recommendations also include an allowance for seasonal rainfall to date. May be advantageous to use N-rich strips.
- 5) Use of different nitrogenous fertilisers and efficiency of use
- 6) Plant tissue testing- Very little currently undertaken. Protocol for tissue sampling for the various crops can be made available.

Plant Establishment

- 1) Is the storage quality of farmer retained seed a problem? Currently, about 80% of seed is retained with 20% being purchased each year. Storage of high moisture grain and damage by stored grain insects could be issues.
- 2) There is a clear understanding of guidelines for plant establishment across the region. Guidelines vary between productivity zones.
- 3) Many of the machines currently being used for direct seeding are disc rather than tynes. More testing needed to identify best type of machine.
- 4) Most trials showed good seeding depth. Press wheels are likely to be useful, to close the furrows and improve seed/soil contact
- 5) Seed treatments are used- unsure of effectiveness

Leaf and Root Disease

- 1) Main leaf and head diseases are Septoria and rusts. Testing for varietal resistance occurs across the region
- 2) Fungicides are available to treat some diseases, although indications are that applications may be, at best, late and often not undertaken at all. The capacity to apply foliar fungicides on time could be a limitation.
- 3) Main root diseases are Fusarium and Take-all. Crop sequencing will be an important means of control

Varieties

- 1) Good genetic material seems available for most traditional crops.
- 2) However, availability of seed is an ongoing issue, particularly for rotation crops such as vetch and canola
- 3) Canola is likely to have a place in crop sequences but needs market development. May be potential for use of various herbicide tolerant options
- 4) Potential to improve decision making around crops and varieties for different nitrogen and soil water situations

Crop Sequences

- 1) May need to aim at crops which leave residues in place. As an example, lentils leave very low levels of residue post-harvest.

Resource Material

The following resource material was provided to WUE participants

1. GRDC Publication-Water use efficiency of grain crops in Australia: principles, benchmarks and management. Authors Victor Sadras and Glenn McDonald
2. ESTIMATING PLANT AVAILABLE WATER CAPACITY-A METHODOLOGY L. Burk and N.P. Dalgliesh
3. A guide to consistent and meaningful benchmarking of yield and reporting of water-use efficiency. James Hunt & John Kirkegaard, CSIRO Sustainable Agriculture Flagship