Iraq-ICARDA-Australia Project (ACIAR CIM/2004/024):

Better crop germplasm and management for improved production of wheat, barley and pulse and forage legumes in Iraq

Second Technical Report
November 2006 - September 2007

Technical results from information presented at the project reporting and planning meeting 1-6 September 2007

at

International Center for Agricultural Research in the Dry Areas

ICARDA

Aleppo, Syria

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Summary

This second project technical report presents technical results from demonstrations and research conducted during the second cropping season (2006-07) under the Iraq-ICARDA-Australia Project (ACIAR CIM/2004/024). The project is evaluating better crop germplasm and management for improved production of wheat, barley and pulse and forage legumes to improve cereal and legume production in the rainfed areas of Ninevah Governorate in Iraq. This report is one of the series of technical reports over the 2005-08 duration of the project, which is intended to document project findings and provide a technical base to support the final project goal of encouraging farmers to adopt well-adapted technologies in order to improve livelihoods.

The project is being implemented collaboratively through the Ministry of Agriculture and the Ninevah Directorate of Agriculture (MOA and DOA), the University of Mosul (UM), the International Center for Agricultural Research in the Dry Area (ICARDA) and three Australian institutions (University of Adelaide, University of Western Australia/Centre for Legumes in Mediterranean Agriculture, Department of Agriculture of Western Australia).

The project workplan for 2006-07 was developed at the project reporting/planning meeting at ICARDA on 1-5 October 2006 with ICARDA, Iraqi and Australian scientists. The workplan is included in the "Minutes and 2006/07 Workplan, Iraq-ICARDA-Australia Project (ACIAR CIM/2004/024) Better crop germplasm and management for improved production of wheat, barley and pulse and forage legumes in Iraq, Project reporting and planning meeting, 1-5 October 2006, ICARDA, Aleppo, Syria, 28pp".

It was planned to undertake the following demonstration and research activities:
• 35 variety x agronomy demonstrations (24 cereals, 9 food legumes, 2 forages)
• 37 research yield trials (24 cereals, 7 food legumes, 3 forages, 3 agronomy).

Two tonnes of ICARDA seed to support the R & D program was sent to Mosul, arriving on 16 December 2006. Other necessary seed was saved from the 2005-06 harvest in Ninevah.

Project implementation was overseen by the Ninevah Implementation Committee, set up by MOA to manage the project. Although the Committee could not meet regularly in Mosul in 2006-07 due to security concerns, the project leader and members interacted and visited demonstration sites regularly to plan and discuss activities and progress.

The agreed demonstration program was well implemented across 12 locations with crops compared under farmer, improved tillage, and zero-tillage establishment. The highlight was the success of the zero-till technology, which had reportedly never been tried before in Iraq. Considering all the traits measured under the three planting methods in barley, bread wheat and durum wheat, the chisel planting method gave the highest values in a total of 36 site/trait combinations followed by zero-tillage in 28 and farmer methods in 8. This result provides strong encouragement that the new zero-till technology, with its many benefits in terms of productivity, sustainability and economics, will be attractive for farmers. Research and demonstration will be continued to refine and promote the technology. Farmer field days/inspections were held at all sites and there was strong farmer interest in zero-tillage.

In the research program in Ninevah, only part of the planned program of 37 research trials (24 cereals, 7 food legumes, 3 forages, 3 agronomy) could be implemented. There were reportedly 14 trials undertaken included yield/nursery trials for bread wheat (2), durum wheat (2), barley (3), chickpea (2), lentil (1), faba bean (2), vetch (1) and an agronomy management/rotation trial, although the results from some of these were not presented in the Project reporting and planning meeting held on 2-6 September 2007 at ICARDA and are not presented in this report. As in the first year, several of the new introduced lines performed well and will be retained in the program for further testing.

IPM studies on the wheat leaf miner *Syringopais temperatella* Led. in the AlHamdania and Telkief demonstrations conducted by Mosul University suggested that the level of insect infestation and damage are affected by variety selection and crop establishment method. Zero-tillage, which has many advantages, generally seemed to reduce leaf miner infestations and damage.

Seed of promising lines/varieties of interest was saved from demonstration, research and seed-increase plots for the 2007-08 program.

In the research program at ICARDA, four trials were conducted comparing zero-tillage and conventional cultivation in wheat, barley, oats, chickpea and lentil. Yields were similar or higher with zero-tillage, confirming the potential of the technology for the region. The trials were inspected and discussed with several visiting Iraqi scientist and farmer groups. On-farm demonstration with zero-tillage and stubble mulching were undertaken in Barkoum Village near ICARDA. The Indian zero-till seeder worked well in farmer fields, even on stony soils. A large field day was held and local cooperating farmers were very interested in zero-tillage and stubble retention. The testing of varieties/lines of oats, peas, canola and other oilseeds from Australia with potential for adaptation and use in Iraq to diversify cropping systems continued but, unfortunately, establishment was poor and trials could be harvested. However, seed multiplication of promising varieties/lines of oats was successful, with Mitika and Possum giving the highest grain yields of nearly 1 t/ha.

As could be expected, there were many problems implementing the project given the political and security situation in Iraq. Demonstration and research activities were constrained by security concerns, land disputes, lack of machinery, and funding and transport shortages. The impossibility of in-country field visits by ICARDA and Australian collaborators to inspect and interact on trials/demonstrations continued to be a disadvantage.

Nevertheless, considering constraints, the project has continued to go well in 2006-07 because of the enthusiasm, industry, flexibility and dedication of Iraqi collaborators; the strong interest and support of ICARDA and Australian collaborators; and the proximity of ICARDA. This is evidenced by the detailed reports that follow on the wide range of activities undertaken by the project and the identification of some promising better-adapted varieties and more productive and sustainable conservation cropping technologies for the rainfed cropping farmers of Iraq. A project highlight has been the introduction and testing of zero-till/stubble retention crop establishment technology, reportedly for the first time in Iraq, which has shown a promise and acceptance that is likely after more local testing and refinement to lead to widespread adoption of the technology, as has happened in many overseas countries over the past 30 years.

1. Introduction

Ninevah Governorate in Iraq is considered a rainfed area; most of the agriculture depends totally on rainfall. According to the amount of rainfall received it is classified into high (HRA) medium (MRA) and low (LRA) rainfall areas. In order to develop agriculture in the Governorate, an extension and research project is being undertaken in collaboration with the Ministry of Agriculture and the Ninevah Directorate of Agriculture (MOA and DOA), the University of Mosul (UM), the International Center for Agricultural Research in the Dry Area (ICARDA) as well as several Australian institutions (University of Adelaide, University of Western Australia/Centre for Legumes in Mediterranean Agriculture, Department of Agriculture of Western Australia). Collaborating institutions and scientists are listed in Section 6.

The aim of the project is to improve cereal and legume production in the rainfed areas in Ninevah Governorate in Iraq, through the introduction of improved varieties for each rainfall area along with improved crop management technologies, to increase productivity, profitability and resource conservation of local cropping systems. The final goal is to encourage farmers to adopt these technologies in order to improve livelihoods. The project has a demonstration component to evaluate and promote best-bet varieties and technologies, and a research component to evaluate the adaptation of new varieties/lines as well as the suitability of new conservation cropping technologies. The demonstration program is conducted by DOA and the research program by MOA Ninevah and UM.

2. General demonstration management

The workplan for the demonstration program was developed and agreed at the annual reporting/planning meeting at ICARDA on 1-5 October 2006. DOA agricultural sections formed working teamsincluding all specialties to implement and manage the field demonstrations from sowing to harvest. Locations of demonstration sites are mapped in Appendix 1.The evaluations involved comparisons of different varieties of durum wheat, bread wheat, barley, pulses (fababean, chick pea, lentil) and forage legumes grown under traditional farmer management (control) and several improved demonstration management systems (chisel cultivation and zero-tillage). An area of one hectare (= 4 Iraqi donum) per cultivar was allocated for crop establishment/management comparisons. The amount of fertilizer added was determined according to soil analysis. Plowing for improved management (chisel) was carried out using a chisel plough followed by disc plough and for farmer management by disc plough only; the zero-till plots were not cultivated. Sowing of seed and fertilizer was carried out using tractor-drawn seeders, with the zero-till plots sown with an Indian zero-till seeder. Details of the each site, the crops/varieties grown, and management activities are presented in Appendix 2. Rainfall at demonstration sites is presented in Appendix 3.

Sites used were the same as in 2005-06 as follows:

LRA locations: annual rainfall lower than 200 mm

- Hatra
- Tell Abta
- Mahalabia

MRA locations: annual rainfall 200-400mm

- Telkief
- Hamadania
- Bashika

HRA locations: annual rainfall over 400mm

- Rabia
- Al Koush
- Al Shikhan

Supplementary Irrigation (SI) locations

- Rabia
- Hummaidat

- Nimrud

3. Demonstration reports

3.1 Cereals

Implemented by:
Staff Members of DOA in Ninevah

General Coordinator:
Dr. Salih M.Bader (MOA)

Report prepared and presented by:
Dr Abdulsattar A. ALRijabo, Project Manager

3.1.1 Introduction

Nineveh Governorate is considered a rain fed area where most of the agricultural area depends totally on rainfall. The rain fed area was classified into three zones according to the amount of rainfall; they are: HRA, MRA&LRA.

In order to develop the agricultural process in the governorate , an extension research project was undertaken in coordination between the Iraqi MOA / DOA (Nineveh) and the International Center for Agriculture Research in the Dry Areas (ICARDA). The aim of the project was to improve cereal and legume production in the rain fed areas in Nineveh governorate through the introduction of suitable varieties for each area along with the use of new agricultural technologies to reduce the production cost to a minimum and to ensure better crop production. The final goal is to encourage farmers to adopt these technologies in order to improve their production.

This is the first year we used the Z.T. planting method in our program, so we must know what Z.T. is and what are the benefits of it? To answer these questions we searched international Z.T. studies and literature to review results and experiences in many countries.

1 – No -Till in Australia

The Western Australian No-Tillage Farmers Association (WANTFA) estimated that 40per cent of farmers in WA may have no-tilled in 1998.

What is no-till?
No-till is sowing a crop without prior cultivation and with very little soil disturbance at seeding.

Why no-till?
The main benefits of no-till, with appropriate agronomic management, include:

- almost no soil erosion through stubble retention and proper grazing management (especially in sandy soils)
- greater flexibility of farm operations through less time used at seeding and improved soil structure and more timely seeding and other operations
- more water harvested to grow the crop in dry areas; less labour, fuel and machinery costs per hectare.

On which soil?
All soils can be no-tilled! In sandy soils, no-till with stubble retention minimises wind erosion and where it leaves furrows, makes water harvesting easier in water repellent soils. In clay and loamy soils, no-till minimizes run-off and erosion by water and improves soil structure.

Pre-season preparation

By controlling weeds, which are hosts to diseases, problems with both weeds and diseases are reduced. However, the year before seeding good stubble management is also essential.
(Ross et . al . (1999) No-Till Essentials – Miscellaneous publication – Australia).

Stubble retention :
The retention of crop residues has built up slowly as a practice in Western Australia over the 1980's & 1990's in place of incorporation or burning. Adoption has been mainly a response to wind & water erosion hazards & to the decline in soil structure. Recorded yield increases due to stubble retention in Australia have been variable, & not always positive in the short term. However, experimental evidence is beginning to emerge after some years of stubble retention that soil properties & grain yield have increased compared with annual burning of stubbles.

Zero tillage :
The use of no-or zero tillage (i.e. sowing with virtually no soil disturbance, with or without stubble burning) has been widely adopted in Western Australia since the early 1990's as a logical extension of the earlier developments in reduced tillage & one-pass seeding. There is little published evidence that crops sown on the same day using a zero-tillage system as those sown with some form of cultivation have resulted in yield increases. However, the saving in fuel cost and the convenience of being able to sow closer the optimum time have contributed to profits in many circumstances. The system is dependent on the use of chemical weed control and, along with several other modern practices, has contributed to the development of herbicide-resistant weeds, thus extending a further challenge to farm managers researches (Anderson et . al (2005) The role of management in yield improvement of the wheat crop-are view with special emphasis on WA - Australian of Agric . Research ,56 ,1137-1149)

2 – No-Till in USA
Soil erosion by water or wind is a serious problem on approximately one million acres of land in California's hills and valleys traditionally used for production of barley and wheat. Exposure of tilled soil on sloping ground can result in erosion and lead to loss of productivity and transport of sediment into streams and lakes even where total annual rainfall is very low. Although there are several options available to farmers for protecting soil from erosion, nationally, farmer have chosen methods that use crop management on approximately 75 percent of the acres covered by conservation compliance plans .Crop residue management methods inclued several types of conservation tillage, including no-till.

In California, many small grain producers use minimum tillage, reducing the number of tillage operations, adjusting chisels, discs, and cultivators to leave sufficient crop residue levels to qualify as conservation tillage according to USD definitions. A small number of grain farmers are using no-till.

In no-till farming, as the name implies, tillage for seedbed preparation and weed control is avoided entirely. The only mechanical disturbance to soil is in a narrow slot or strip made by the planter or by fertilizer knives. Weeds are controlled with herbicide applications instead of tillage. Potential advantages of no-till besides a reduction in soil erosion are a reduction in use of fuel (due to less cultivation) and increased capture of runoff due to improvement in tilth of the soil surface. Some no-till growers believe that in no-tilled fields (due to improved infiltration and reduced run-off) enough moisture is stored in the root zone that back-to-back cropping becomes possible whereas under conventional tillage, a moisture-conserving fallow was necessary. Moisture availability aside, two potential advantages of reducing the frequency of fallow are 1) greater production of crop residues and 2) production of income every year.

Fertilization in No-Till Systems:
Both N and P fertilizers should be placed in sub-surface bands rather than be broadcast on the surface . This is good advice regardless of the tillage system, but it is especially true for no-till. Plant

residues present on the surface of the soil in a no-till system may immobilize inorganic forms of fertilizer due to microbial activity.

Impacts on Soil Organic Matter:
Reduced tillage systems affect the distribution of organic matter in the soil, increasing the organic matter and nitrogen content of the surface soil compared to conventional tillage. This is a result both of reduced contact of residues with soil microbes and accessibility of dry matter to oxygen In one study, researchers measured 43% more total N in the top two inches of soil in untilled soil compared to conventionally tilled soil after six years.

Impact on Water Infiltration and Water – Holding Capacity:
Some growers in California and elsewhere state that in no-tilled fields, they see less runoff and better water infiltration (Pettygrove et. al 1995 No-Till wheat and Barley production in California – Univ. of California Energy Commission)

3 – No-Till in Africa:
Changing from Conventional to Conservation Tillage:
Before starting with conservation tillage, some soil issues associated with cultivation may have to be corrected. This means that major constraining factors caused by conventional tillage have to be adjusted.

Breaking of soil compaction layers especially plough layers or hard pans by:
- Mechanical measures - subsoiling by use of tractors or draught animals
- Biological measures - fallows with plants forming taproots which can penetrate and break the hardpan (e.g. pigeon pea, oil radish) and/or adjustment of PH through application of lime farm yard manure.

The main functions of soil organic matter (SOM):
- Improvement of soil structure
- Increased water storage capacity
- Slow release of plant nutrients

Major effects of conservation tillage on soil characteristics:
- Reduced soil erosion by wind and water
- Reduced water run-off = loss of water
- Increased water infiltration and storage
- Reduced evaporation
- Prevention of overheating of the soil surface affecting seed germination
- Build up of SOM
- Improved aggregate stability and soil structure, but increased bulk density
- Deepening of rooting horizon through earthworms and roots of deep rooting green manure plants

Soil life:
The soil must be understood as a living organism. Only a living soil, with abundant soil life, can fulfil its main functions. Tillage operations disturb the soil life. Soil organisms are suddenly exposed to the sun, heat, and dehydration. The number of soil biota decreases rapidly and builds up only slowly during the growing season. Under no-tillage and to a lesser extent under minimum-tillage soil life is not disturbed. The soil cover helps to create a more stable environment and the organic matter serves as 'fodder" for the soil biota. Soil biota improve the soil structure .The micro fauna and flora improve the soil structure by forming stable soil aggregates, while the macro fauna forms macropores which are important for water infiltration and aeration (Kurt S. (2002) Conservation

Tillage Gateway to food security and sustainable Rural Development Impact of Conservation Tillage on Soil Quality. Univ of Zimbabwe).

4 – New tillage practices for South Asia

For decades the continuous rotation of rice and wheat (two crops or more per year) has provided food and livelihoods for hundreds of millions of rural and urban poor in South Asia. Now a crisis looms. The population is growing at more than 2% (nearly 24 million additional mouths to feed) each year. Yet agricultural land area dwindles and yield increases are leveling off. In the next two decades, fresh water will become increasingly scarce in South Asia, and water tables in some areas are already dropping as much as one meter per year. Finally, heavy diesel use and crop residue burning pose local health hazards and add significantly to global warming.

Simple changes, astonishing benefits

Alternative tillage practices that reduce costs and raise productivity are being tested and promoted by the Rice-Wheat Consortium for the Indo-Gangetic Plains. It turns out that widespread adoption of one or several of these reduced tillage methods will also bring significant environmental benefits.

For example, current land preparation practices for wheat after rice involve as many as 12 tractor passes. Changing to a zero-till system on one hectare of land would save 98 liters of diesel and approximately 1 million liters of irrigation water. Using a conversion factor of 2.6 kg of carbon dioxide per liter of diesel burned, this represents about a quarter ton less emissions per hectare of carbon dioxide, a principal contributor to global warming. These benefits increase dramatically if extended across even a portion of the rice-wheat region's 12 million hectares. Adoption of zero-till on, say, 5 million hectares would represent a savings of 5 billion cubic meters of water each year. That would fill a lake 10 km long, 5 km wide, and 100 m deep. In addition, annual diesel fuel savings would come to 0.5 billion liters - equivalent to a reduction of nearly 1.3 million tons in CO^2 emissions each year.

Scientists in the Rice-Wheat Consortium (RWC) are also working with farmers to cut down on the burning of crop residues, which amount to as much as 10 t/ha, producing some 13 ton of carbon dioxide. Eliminating burning on just 2 million hectares would reduce the huge flux of yearly CO^2 emissions by 17 million tons. Leaving stubble on the field, rather than burning it or incorporating it, also leaves a better habitat for beneficial insects to proliferate - a benefit that has not yet been quantified.

How likely are these scenerios?

Alternatives to burning residues are still in the exploratory stage, but reduced tillage practices are catching on quickly, simply because they are so attractive to farmers. For example, two methods promoted by the RWC - direct drilling and surface seeding—allow farmers to prepare soils and sow wheat in a single tractor operation after the rice harvest. How can one argue with a practice that saves 75% or more fuel, obtains better yields, uses about half the herbicide, and requires at least 10% less water? Farmers save at least US$ 65/ha in production costs, which makes a big difference to their profit margin.

This year, farmers used direct drilling with locally manufactured drills to plant 8,000 ha in Haryana State, India, and 5,000 ha in the Pakistan Punjab. The area of adoption has increased ten-fold each year for several years. The main constraint on more rapid expansion has been a lack of good quality, fairly priced seed drills. Small private shops are beginning to produce more drills in response to rising demand.

Small-scale mechanization is also spreading in the form of the two-wheel tractor and a range of new implements. Used widely by smallholders in China and Bangladesh, two-wheel tractors are being tested as a one-pass, reduced- tillage system and adopted by farmers in Nepal and eastern India for

more timely sowing and reduced labor and land preparation costs. There the need is for more tractors, repair shops, mechanics and credit support to purchase equipment.

Another recently promoted technique-planting wheat on raised beds-improves yields, increases fertilizer efficiency, reduces herbicide use, saves seed, saves an average 30% water, and can reduce production costs by 25-35% when permanent beds are used. Bed planting is gaining acceptance in Pakistan and is being tested by researchers in India and Nepal.

To help make seed drills, hand tractors, and tractor implements more widely available, RWC staff are linking and advising farmer groups, local machine shops, and agricultural engineering specialists. CIMMYT and the RWC are also developing appropriate planters and bed-shaping equipment so that farmers can maintain permanent beds and retain crop residues. This adds the advantages of conservation tillage to bed planting, reducing costs another 20-25% (Raj Gupta and Peter Hobbs – CIMMYT, India/Nepal).

3.1.2 Demonstration program

The demonstration program in 2006-07 had two components:

a) comparison of crop performance under three crop establishment techniques (farmer method, chisel cultivation, zero-tillage) with several cultivars/lines of major crops at 12 sites (4 rainfall zones x 3 locations)

b) comparison of crop performance of a range of varieties/lines of barley and wheat (one MRA location)

3.1.2.1 Comparison of performance of various crops/varieties under three crop establishment techniques

3.1.2.1.1 Materials and methods

The Tables A-L in Appendix 2 show the varieties which were used in demonstration and control treatments according to locations and planted area and include details of all activities such as ploughing, seed rate (kg/ha), date of sowing and fertilizer dosages and of the soil texture and average rainfall. Whilst experimental treatments (zero-tillage, chisel cultivation) were compared with the traditional crop establishment method of the farmer, it is worth mentioning that the farmer was supplied with the same varieties seeds.

Summary of soil texture at demonstration locations

Location	Clay +Silt %	Clay %	Silt	Sand %	Soil texture
Tell Abta	72.9	29.7	43.2	27.1	Clay loam
AL-Hatra	49.55	24.7	24.9	50.5	Sandy clay loam
AL-Mahalabia	46.2	7.5	38.7	53.9	Sandy loam
Bashyqa	54.7	16.2	38.5	45.3	Sandy loam
Telkief	67.1	35.0	31.1	33.0	Clay loam
AL-Hamdania	54.0	22.5	31.5	46.1	Loam
AL- Qush	68.7	25.0	43.7	31.4	Loam
AL-Shykan	64.0	30.0	40.0	36.1	Clay loam
Rabiaa	72.8	38.8	34.0	27.3	Clay loam
AL–Namroud	66.4	25.0	41.3	33.7	Loam
Hamidat	69.4	42.5	26.9	30.6	Clay

The following traits were studied, with the data collected from 3 random $1m^2$ replicates (quadrats). The experimental design for this factorial experiment was RCBD with 3 replicates, and we used

Duncan Test for testing significantly between date results. All data were analyzed by computer program in the University of Mosul Agriculture College by Dr. Salim Hummadi Anter.

- plant height (cm): height of 10 plants for each replicate and the mean calculated
- straw biomass (gm/m^2): weight of straw for each replicate and the mean calculated
- spikes/m^2: number of spikes/m^2 for each replicate and the mean calculated
- seeds /spike: number of seeds for ten spikes from each replicate and the mean calculated
- weight of 1000 grains (gm): grain weight of 1000 grains from each replicate and the mean calculated
- specific weight (kg/hectoliter): specific weight for each replicate if available and the mean calculated
- weight of grain (gm/m^2): grain yield from each replicate, and the mean calculated
- grain yield (kg/hectare): grain yield after harvesting the total area and measuring actual weight of grain

3.1.2.1.2 Results

3.1.2.1.2a Effect of planting methods on growth and yield traits of barley in LRA locations

A-1- Grains yield Trait.

A-1-1-Grain Yield (gm/m^2) Trait:

The best grains yield (gm/m^2) according to factors and interactions (Table 1) are summarized below:
Planting Methods (P) = ZT
Cultivars (C) = Local black and Zanbaka (NS)
Locations (L) = Tel Abta Location
L × C interaction = Zanbaka in Tel Abta location
L × P interaction = ZT in Tel Abta location
C × P interaction = Zanbaka under ZT planting method
L × C × P interaction = Zanbaka under ZT and conventional planting methods and local black under ZT planting method (NS) in Tel Abta location

A-1-2-Grain Yield (Kg/Hectare) Trait:
As shown in Fig 1, the best grain yields were 468kg/ha in Zanbaka under ZT then 444kg/ha in local black under ZT in Tell Abta location

Table 1 Effect of planting methods on grains yield (gm/m^2) of barley in LRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHatra	Local Black barley	28.66	-	18.216	23.44
	Zanbaka	23.90	-	25.68	24.79
Tell Abta	Local Black barley	85.96 b	86.76 b	142.38 a	105.03 b

	Zanbaka	146.26 a	55.53 c	146.53 a	116.11 a
ALMahalabia	Local Black barley	24.60 ef	58.85 c	44.83 d	42.76 c
	Zanbaka	19.68 f	33.75 e	44.42 d	32.62 d
					(L)
L x P Interaction	Tell Abta	116.11 b	71.15 c	144.46 a	110.57 a
	ALMahalabia	22.14 e	46.30 d	44.63 d	37.69 b
					(C)
C x P Interaction	Local Black barley	55.28 d	72.81 c	93.61 a	73.90 a
	Zanbaka	82.97 b	44.64 e	95.48 a	74.360 a
(P)		69.13 b	58.73 c	94.54 a	

A-2- No. of Spikes /m2:

As shown in Table 2 the best results for spikes/ m^2 in factors and interactions are summarized below:
P = ZT
C = Local Black
L = Tell Abta
L × C = Local Black in Tell Abta
L × P = ZT in Tell Abta
C × P = Local Black and Zanbaka (N.S) under ZT.
L × C × P = Local Black then Zanbaka under ZT in Tell Abta

Table 2 Effect of planting methods on spikes/m^2 of barley in LRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHatra	Local Black barley	173.00	-	131.00	152.00
	Zanbaka	116.00	-	150.33	133.17

Tell Abta	Local Black barley	246.66 c	227.00 d	366.66 a	280.11 a
	Zanbaka	292.66 b	153.00 f	297.66 b	247.77 b
ALMahalabia	Local Black barley	92.33 h	180.66 e	98.00 h	123.66 c
	Zanbaka	92.66 h	116.66 g	161.30 f	123.55 c
					(L)
L x P Interaction	Tell Abta	269.66 b	190.00 c	332.16 a	263.92 a
	ALMahalabia	92.47 f	148.63 d	129.65 e	123.58 b
					(C)
C x P Interaction	Local Black barley	169.50 d	203.83 b	232.33 a	201.88 a
	Zanbaka	192.66 c	134.83 e	229.48 a	185.63 b
(P)		181.04 b	169.32 c	230.91 a	

A-3-Weight of 1000 Grains (gm):

As shown in Table 3 the best results of Weight of 1000 Grains (gm) in factors and interactions are summarized below:

P = all planting methods (NS)
C = Zanbaka and Local black (NS)
L = Tell Abta
L × C = Zanbaka in Tell Abta
L × P = Z.T. in Tell Abta
C × P = Zanbaka under ZT
L × C × P = Zanbaka under ZT in Tell Abta

Table 3 Effect of planting methods on weight of 1000 grains (gm) of barley in LRA locations

Location (L)	Planting Method (C) (P) Cultivars	Con.	Chisel	Z.T.	L x C interaction

ALHatra	Local Black barley	26.2	-	25.98	26.09
	Zanbaka	25.80	-	28.93	27.37
Tell Abta	Local Black barley	28.73 bc	34.06 ab	32.93 abc	31.91 ab
	Zanbaka	34.86 ab	32.47 abc	37.33 a	34.88 a
ALMahalabia	Local Black barley	28.20 bc	31.33 abc	25.60 c	28.38 b
	Zanbaka	29.00 bc	30.80 abc	31.66 abc	30.49 b
					(L)
L x P Interaction	Tell Abta	31.80 ab	33.27 ab	35.13 a	33.40 a
	ALMahalabia	28.60 b	31.07 ab	28.63 b	29.43 b
					(C)
C x P Interaction	Local Black barley	28.47 b	32.70 ab	29.27 ab	30.15 a
	Zanbaka	31.93 ab	31.64 ab	34.50 a	32.76 a
(P)		30.20 a	32.17 a	31.88 a	

A-4-No. of Grains/spike .

As shown in Table (4) the best results of No. of grains/spike in factors and interactions are summarized bellows:
P = Chisel
C = Local black and Zanbaka (NS)
L = Tell Abta
L × C = Zanbaka in Tell Abta
L × P = Con. And ZT in Tell Abta (NS)
C × P = Zanbaka under Chisel
L × C × P = Zanbaka under Chisel in Mahalabia

Table 4 Effect of planting methods on grains/spike of barley in LRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHatra	Local Black barley	7.86	-	7.53	7.70
	Zanbaka	8.70	-	10.46	9.58
Tell Abta	Local Black barley	13.96 bc	13.40 cd	13.93 bc	13.76 a
	Zanbaka	14.30 b	13.30 d	14.16 b	13.92 a
ALMahalabia	Local Black barley	13.16 d	12.90 de	13.50 cd	13.19 b
	Zanbaka	11.50 f	15.03 a	12.40 e	12.97 b
					(L)
L x P Interaction	Tell Abta	14.13 a	13.35 b	14.05 a	13.84 a
	ALMahalabia	12.33 c	13.95 a	12.95 b	13.08 b
					(C)
C x P Interaction	Local Black barley	13.56 bc	13.15 cd	13.72 b	13.51 a
	Zanbaka	12.90 d	14.16 a	13.28 cd	13.44 a
(P)		13.23 b	13.65 a	13.50 ab	

A – 5 – Straw Biomass (gm/m^2):

As shown in Table 5 the best results of straw biomass (gm/m^2) in factors and interactions are summarized below:

P = Z T
C = Zanbaka
L = Tell Abta
L × C = Zanbaka in Tell Abta
L × P = ZT in Tell Abta
C × P = Zanbaka under ZT and Control (NS)

L × C × P = Zanbaka under Con. planting method in Tell Abta

Table 5 Effect of planting methods on straw biomass (gm/m^2) of barley in LRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHatra	Local Black barley	31.25	-	22.15	26.7
	Zanbaka	25.05	-	35.10	30.08
Tell Abta	Local Black barley	74.60 c	62.61 d	110.25 b	82.49 b
	Zanbaka	120.25 a	48.75 e	109.23 b	92.74 a
ALMahalabia	Local Black barley	21.60 h	41.48 f	40.35 f	34.48 c
	Zanbaka	34.00 g	25.20 h	44.63 ef	34.61 c
					(L)
L x P Interaction	Tell Abta	97.43 b	55.68 c	109.74 a	87.62 a
	ALMahalabia	27.80 f	33.34 e	42.49 d	34.54 b
					(C)
C x P Interaction	Local Black barley	48.10 c	52.05 b	75.30 a	58.48 b
	Zanbaka	77.13 a	36.98 d	76.93 a	63.68 a
(P)		62.61 b	44.51 c	76.12 a	

A – 6 – Plant Height (cm):

As shown in Table 6 the best results of plant height (cm) in factors and interactions are summarized below:

P = ZT

C = Zanbaka

L = Tell Abta

L × C = Zanbaka in Tell Abta

L × P = Z.T. and Con. in Tell Abta (NS)
C × P = Zanbaka under ZT
L × C × P = Zanbaka under ZT and Con. planting methods (NS) in Tell Abta

Table 6 Effect of planting methods on plant height (cm) of barley in LRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHatra	Local Black barley	28.26	-	26.83	27.55
	Zanbaka	31.80	-	30.46	31.13
Tell Abta	Local Black barley	44.13 c	47.86 bc	47.03 bc	46.34 a
	Zanbaka	50.03 ab	38.30 de	51.86 a	46.73 a
ALMahalabia	Local Black barley	36.33 de	38.20 de	36.70 de	37.08 c
	Zanbaka	36.00 e	40.26 d	46.26 bc	40.84 b
					(L)
L x P Interaction	Tell Abta	47.08 a	43.08 B	49.45 a	46.54 a
	ALMahalabia	36.17 d	39.23 c	41.48 bc	38.96 b
					(C)
C x P Interaction	Local Black barley	40.23 bc	43.03 b	41.87 bc	41.71 b
	Zanbaka	43.02 b	39.28 c	49.06 a	43.79 a
(P)		41.62 b	41.16 b	45.46 a	

A – 7 – Grains Specific Weight (kg/ hectoliter):
As shown in Table 7 the best results of grain specific weight (kg/hectoliter) in factors and interactions are summarized below:
P = Z T and Chisel

C = Local Black
L = Tell Abta
L × C = Local Black in Tell Abta
L × P = ZT and Control (N.S.) in Tell Abta
C × P = Local Black under Control planting method
L × C × P = Local Black under Con. planting method in Tell Abta

Table 7 Effect of planting methods on grains specific weight (kg/hectoliter) of barley in LRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHatra	Local Black barley	-	-	-	-
	Zanbaka	-	-	-	-
Tell Abta	Local Black barley	61.3 a	60.7 ab	60.7 ab	60.90 a
	Zanbaka	60.7 ab	57.6 c	60.0 b	59.44 b
ALMahalabia	Local Black barley	42.3 ef	42.0 f	42.7 ef	42.33 c
	Zanbaka	36.3 g	44.3 d	43.3 de	41.33 d
					(L)
L x P Interaction	Tell Abta	61.00 a	59.16 b	60.33 a	60.2 a
	ALMahalabia	39.33 d	43.16 c	43.00 c	41.8 b
					(C)
C x P Interaction	Local Black barley	51.83 a	51.33 ab	51.67 ab	51.61 a
	Zanbaka	48.50 c	51.00 b	51.67 ab	50.39 b
(P)		50.16 b	51.16 a	51.67 a	

3.1.2.1.2b Effect of planting methods on growth and yield traits of bread wheat in MRA locations

B-1- Grains Yield Trait .

B-1-1- grains yield (gm/m2) trait:
As shown in table 8 the best results of grains yield (gm/m^2) in factors and interaction are summarized below:
P = Chisel
C = Sham/6
L = Tell Kief
L X C = Sham/ 6 in Tell Kief Location.
L X P = Chisel then Z.T in Tell Kief location.
C X P = Sham/6 under Chisel planting location
L X C XP = Sham/6 under Chisel in Tell Kief location

B-1-2 grains yield (Kg/hectar) trait:
As shown in Fig 2 the best grain yield was 1480 kg/ha in Sham/6 under Chisel then 1440 kg/ha in Tellaffer/3 under Chisel in Tell Kief

Table (8) Effect of planting methods on grains yield (gm/m^2) of bread wheat in MRA locations.

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	cham/6	66.45 h	55.32 i	62.92 h	61.56 e
	Abo Ghariab	77.76 g	77.45 g	83.83 fg	79.68 c
Bashyqa	Sham/6	100.15 cd	120.75 b	88.72 ef	103.21 b
	Abo Ghariab	69.18 h	68.10 h	69.60 h	68.96 d
Tellkief	Sham/6	94.50 de	150.55 a	116.13 b	120.39 a
	Abo Ghariab	98.26 d	106.46 c	100.80 cd	101.84 b
	Tell affer/3	117.85	131.25	119.51	122.87
					(L)
	ALHamdania	72.11 f	66.39 g	73.38 f	70.63 c

L x P Interaction	Bashyqa	84.67 d	94.43 c	79.16 e	86.09 b
	Tellkief	96.38 c	128.51 a	108.47 b	111.12 a
					(C)
C x P Interaction	Sham/6	87.03 bc	108.87 a	89.26 b	95.05 a
	Abo Ghariab	81.73 d	84.00 cd	84.74 cd	83.49 b
(P)		84.38 c	96.44 a	87.0 b	

B- 2- Spikes /m^2:

As shown in table 9 the best results for spikes /m2 in factors and interaction are summarized below:

P = Chisel

C = Sham/6

L = Al-Hamdania

L X C = Sham/6 in AL-Hamdania

L X P = Z.T. in AL-Hamdania

C X P = Sham/6 in under Chisel

L X C XP = Sham/6 under Con. Planting method in AL-Hamdania

Table 9 Effect of planting methods on spikes /m^2 of bread wheat in MRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	Sham/6	683.00 a	613.66 c	579.00 d	625.22 a
	Abo Ghariab	448.33 e	443.33 e	642.00 b	511.22 b
Bashyqa	Sham/6	419.66 f	389.66 g	288.66 l	365.99 c
	Abo Ghariab	343.00 i	377.00 h	375.66 h	365.22 c
Tellkief	Sham/6	293.66 l	428.00 f	330.33 j	350.22 d
	Abo Ghariab	264.66 m	332.00 j	310.00 k	302.22 e
	Tell Affer	328.33	343.33	333.60	335.09

					(L)
L x P Interaction	ALHamdania	565.67 B	528.50 c	610.50 a	568.22 a
	Bashyqa	381.33 d	383.33 d	332.17 e	365.60 b
	Tellkief	279.16 g	380.00 d	320.17 f	324.94 c
					(C)
C x P Interaction	Sham/6	465.44 b	477.11 a	399.33 d	447.29 a
	Abo Ghariab	352.00 f	384.11 e	442.53 c	392.88 b
(P)		408.72 c	430.61 a	420.93 b	

B-3-Weight of 1000 grains (gm):

As shown in table 10 the best result of weight of 1000 grains (gm) in factors and interactions are summarized below:

P = ZT

C = Abo Ghariab

L = Tell Kief

L X C = Sham/6 and Abo Ghariab in Tellkief (NS). (Note the height value in Tell Affer cultivar)

L X P = Chisel in Tell Kief

C X P = Abo Gharib under ZT

L X C X P = Sham/6 under Chisel and ZT and Abo Ghariab under Con. Planting in Tell Kief Location.(Note the height value in Tell Affer cultivar under Con. And Z.T.)

Table 10 Effect of planting methods on weight of 1000 grains (gm) of bread wheat in MRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	Sham/6	19.66 c	16.06 def	17.60 d	17.77 c
	Abo Ghariab	14.33 fg	14.07 g	17.05 de	15.15 d
Bashyqa	Sham/6	15.20 fg	15.46 efg	15.40 efg	15.35 d

	Abo Ghariab	21.33 b	21.46 b	22.66 b	21.82 b
Tellkief	Sham/6	29.00 a	30.13 a	30.47 a	29.87 a
	Abo Ghariab	30.65 a	29.82 a	28.82 a	29.76 a
	Tell Affer	32.97	31.38	32.11	32.15
					(L)
L x P Interaction	ALHamdania	17.00 d	15.07 e	17.33 cd	16.46 c
	Bashyqa	18.27 bc	18.46 bc	19.03 b	18.59 b
	Tellkief	29.83 a	29.98 a	29.65 a	29.82 a
					(C)
C x P Interaction	Sham/6	21.29 bc	20.55 c	21.16 bc	21.00 b
	Abo Ghariab	22.10 ab	21.78 b	22.84 a	22.24 a
(P)		21.695 ab	21.165 b	22.00 a	

B-4 – No of grains /spike:

As shown in table 11 the best results of grains/spike in factors and interaction are summarized below:

P = ZT
C = Abo Ghariab
L = Tell Kief
L X C = Abo Ghariab in Tell Kief
L X P = ZT in Tell Kief
C X P = Abo Ghariab under Chisel
L X C XP = Abo Ghariab under Chisel in Tellkief

Table 11 Effect of planting methods on grains /spike of bread wheat under MRA

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction

ALHamdania	Sham/6	11.23 j	13.50 i	14.33 i	13.02 f
	Abo Ghariab	18.70 h	19.16 h	21.10 g	19.65 e
Bashyqa	Sham/6	19.33 h	20.53 g	23.30 f	21.05 d
	Abo Ghariab	28.76 d	31.83 b	28.00 d	29.53 b
Tellkief	Sham/6	25.10 e	23.46 f	28.43 d	25.66 c
	Abo Ghariab	27.90 d	33.33 a	30.57 c	30.60 a
	Tell Affer/3	19.56	25.16	28.43	24.38
					(L)
L x P Interaction	ALHamdania	14.97 g	16.33 f	17.72 e	16.34 c
	Bashyqa	24.05 d	26.18 c	25.65 c	25.29 b
	Tellkief	26.50 c	28.40 b	29.50 a	28.13 a
					(C)
C x P Interaction	Sham/6	18.55 e	19.16 e	22.02 d	19.91 b
	Abo Ghariab	25.12 c	28.11 a	26.56 b	26.60 a
(P)		21.84 c	23.638 b	24.29 a	

B-5 – Straw Biomass (gm/m2):

As shown in table 12 the best results of straw biomass (gm/m^2) in factors and interaction are summarized below:

P = Chisel

C = Abo Ghariab

L = Bashyqa

L X C = Abo Ghariab in Bashyqa. (Note the height value in Tell Affer cultivar)

L X P = chisel in Bashyqa

C X P = Abo Ghariab under chisel

L X C XP = Abo Ghariab under chisel and Z.T. in Bashyqa (Note: the height value in Tell Affer cultivar under Con. and Chisel)

Table 12 Effect of planting methods on straw biomass (gm/m^2) of bread wheat in MRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	Sham/6	85.64 h	80.26 hi	69.03 j	78.31 d
	Abo Ghariab	75.75 i	65.17 j	97.60 g	79.51 d
Bashyqa	Sham/6	141.45 c	143.92 c	119.83 ef	135.07 c
	Abo Ghariab	160.15 ab	163.85 a	163.30 a	162.43 a
Tellkief	Sham/6	125.96 e	155.103 b	143.00 c	141.35 b
	Abo Ghariab	118.17 f	146.80 c	133.25 d	132.74 c
	Tell Affer/3	174.65	179.35	157.46	170.49
					(L)
L x P Interaction	ALHamdania	80.70 d	72.72 e	83.32 d	78.91 c
	Bashyqa	150.80 a	153.89 a	141.57 b	148.75 a
	Tellkief	122.07 c	150.95 a	138.13 b	137.05 b
					(C)
C x P Interaction	Sham/6	117.68 c	126.43 b	110.62 d	118.24 b
	Abo Ghariab	118.02 c	125.27 b	131.38 a	124.89 a
(P)		117.85 c	125.85 a	121.00 b	

B-6 – Plant height (cm):

As shown in table 13 the best results of plant height (cm) in factors and interaction are summarized below:

P = ZT
C = Abo Ghariab
L = Tell Kief
L X C = Abo Ghariab in Tell Kief. (Note the height value in Tell Affer cultivar)
L X P = Z.T in Tell Kief
C X P = Abo Ghariab under ZT
L X C X P = Abo Ghariab under ZT in Tell Kief location. (Note: the height value in Tell Affer cultivar under all planting methods)

Table 13 Effect of planting methods on plant height (cm) of bread wheat in MRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	Sham/6	35.76 h	39.83 gh	38.80 gh	38.13 d
	Abo Ghariab	40.66 gh	36.13 h	43.40 fg	40.06 d
Bashyqa	Sham/6	47.20 ef	46.13 ef	52.46 cd	48.60 c
	Abo Ghariab	56.43 abc	54.86 bc	56.23 abc	55.84 ab
Tellkief	Sham/6	49.60 de	53.93 bcd	57.46 abc	53.66 b
	Abo Ghariab	57.00 abc	58.10 a	60.40 a	58.50 a
	Tell Affer/3	64.96	72.80	70.23	69.33
					(L)
L x P Interaction	ALHamdania	38.21 e	37.98 e	41.10 e	39.10 c
	Bashyqa	51.82 cd	50.50 d	54.35 bc	52.22 b
	Tellkief	53.30 bcd	56.02 ab	58.93 a	56.08 a
					(C)
C x P Interaction	Sham/6	44.19 c	46.63 c	49.57 b	46.80 b
	Abo Ghariab	51.36 ab	49.70 b	53.34 a	51.47 a

(P)	47.775 b	48.165 b	51.455 a	

B-7 – Grains Specific weight (Kg/hectoliter):

As shown in table 14 the best results of this trait in factors and interaction are summarized below:

P = All planting methods (NS)

C = Sham/6 and Abo Ghariab (NS)

L = Al Hamdania

L X C = Abo Ghariab in Al Hamdania

L X P = Chisel in Al Hamdania

C X P = Sham/6 under Chisel and Abo Ghariab under ZT

L X C X P = Abo Ghariab under Chisel in Al Hamdania location

Table 14 Effect of planting methods on grains specific weight (kg/hectoliter) of bread wheat in MRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	Sham/6	70.0 abc	70.0 abc	70.0 abc	70.00 ab
	Abo Ghariab	70.3 ab	71.0 a	70.3 ab	70.55 a
Bashyqa	Sham/6	69.7 bc	70.0 abc	69.3 bcd	69.89 b
	Abo Ghariab	70.0 abc	69.7 bc	70.0 abc	69.89 b
Tellkief	Sham/6	68.0 ef	69.0 cde	68.0 ef	68.33 c
	Abo Ghariab	68.3 def	65.3 g	67.3 f	66.97 d
	Tell Affer/3	69.0	70.3	68.7	69.33
					(L)
L x P Interaction	ALHamdania	70.17 ab	70.50 a	70.17 ab	70.28 a
	Bashyqa	69.83 ab	69.83 ab	69.67 b	69.78 b
	Tellkief	68.17 c	67.17 b	67.67 cd	67.67 c

					(C)
C x P Interaction	Sham/6	69.22 ab	69.67 a	69.11 ab	69.33 a
	Abo Ghariab	69.55 a	68.67 b	69.22 ab	69.14 a
(P)		69.39 a	69.17 a	69.17 a	

3.1.2.1.2c Effect of planting methods on growth and yield traits of durum wheat in MRA locations

C – 1- Grains Yield Trait :
As shown in Table15 the best results of this trait in factors and interactions are summarized below:
P = Chisel
C = OM Rabia and Karonia (NS)
L = Tell Kief
L × C = Karonia in Tell Kief
L × P = Chisel in Tell Kief
C × P = Karonia under Chisel Planting
L× C × P = Karonia under Chisel then Z T in Tell Kief

C- 1 – 2 – grains yield (kg/ hectar) trait :
As shown in Fig 3 the best results of grains yield was 1360 kg/ha in Karonia under ZT planting method in Tell Kief location

Table 15 Effect of planting methods on grains yield (gm/m^2) of durum wheat in MRA locations.

Location (L)	Planting Method (C) (P) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	OM Rabia	137.68 f	102.92 jk	99.72 k	113.44 c
	Karonia	117.36 hi	123.98 g	106.55 j	115.96 c
Tellkief	OM Rabia	123.46 g	166.50 c	141.80 f	143.92 b
	Karonia	148.20 e	197.55 a	176.50 b	174.08 a
Bashyqa	OM Rabia	154.82 d	157.25 d	112.68 i	141.58 b
	Karonia	100.43 k	122.08 gh	90.73 L	104.41 d

	Sham/5	151.10	188.58	91.48	143.72
					(L)
L x P Interaction	ALHamdania	127.52 d	113.45 e	103.14 f	114.70 c
	Tellkief	135.83 c	182.03 a	159.15 b	159.00 a
	Bashyqa	127.63 d	139.67 c	101.71 f	123.00 b
					(C)
C x P Interaction	OM Rabia	138.65 c	142.22 bc	118.07 e	132.98 a
	Karonia	122.00 de	147.87 a	142.59 d	131.48 a
(P)		130.325 b	145.045 a	121.33 c	

C – 2 – No . of Spikes/ m2 :

As shown in Table 16 the best results of this trait in factors and interactions are summarized below:

P = Chisel .

C = OM Rabia .

L = AL Ham dania .

L × C = OM Rabia in Al Hamdania location .

L × C = Chisel in Al Hamdania location .

C × P = OM Rabia under Chisel planting method .

L × C × P = OM Rabia under Chisel planting method in Al Hamdania location.

Table16 Effect of planting methods on No. of spikes / m^2 of durum wheat in MRA locations.

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	OM Rabia	522.00 c	659.33 a	531.66 b	570.99 a
	Karonia	291.66 i	439.33 d	291.33 i	340.77 b

Tellkief	OM Rabia	233.00 m	267.33 j	241.33 L	247.22 f
	Karonia	376.60 f	320.00 h	244.30 kl	313.63 d
Bashyqa	OM Rabia	352.60 g	396.60 e	212.30 n	320.55 c
	Karonia	289.33 i	293.00 i	249.66 k	277.33 e
	Sham/5	317.00	366.30	174.00	285.77
					(L)
L x P Interaction	ALHamdania	406.83 b	549.33 a	411.50 b	455.88 a
	Tellkief	304.80 e	293.67 f	242.82 g	280.43 c
	Bashyqa	320.97 d	344.80 c	230.98 h	298.91 b
					(C)
C x P Interaction	OM Rabia	369.20 b	441.09 a	328.43 d	379.57 a
	Karonia	319.20 d	350.78 c	261.76 e	310.58 b
(P)		344.22 b	395.93 a	295.095 c	

C – 3 – Weight of 1000 Grains (gm) :

As shown in Table (17) the best results of this trait in factors and interactions are summarized below:

P = Control planting method .

C = Karonia .

L = Tell kief .

L × C = Karonia then OM Rabia in Tell kief .

L × P = Z .T . and Chisel and con. in Tell kief .

C × P = Karonia under Chisel and OM Rabia under Con.

L × C × P = Karonia under Z .T . and Chisel and Con in Tell kief location.

Table 17 Effect of planting methods on weight of 1000 grains (gm) of durum wheat in MRA locations.

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	OM Rabia	25.20 f	22.46 h	20.73 i	22.80 e
	Karonia	29.13 cd	24.33 fg	27.80 de	27.09 c
Tellkief	OM Rabia	31.83 b	31.87 b	32.80 ab	32.17 b
	Karonia	32.68 ab	33.04 ab	33.93 a	33.21 a
Bashyqa	OM Rabia	29.60 c	24.80 f	27.20 e	27.20 c
	Karonia	23.60 fgh	29.46 cd	22.86 gh	25.31 d
	Sham/5	26.00	32.36	27.13	28.50
					(L)
L x P Interaction	ALHamdania	27.17 b	23.40 d	24.27 cd	24.94 c
	Tellkief	32.26 a	32.46 a	33.37 a	32.69 a
	Bashyqa	26.60 b	27.13 b	25.03 c	26.25 b
					(C)
C x P Interaction	OM Rabia	28.88 a	26.38 b	26.91 b	27.39 b
	Karonia	28.47 a	28.94 a	28.19 a	28.53 a
(P)		28.675 a	27.66 b	27.55 b	

C – 4 – No . of Grains/ Spike :

As shown in Table (18) the best results of this trait in factors and interactions are summarized below:

P = Z . T . and Chisel .

C = Karonia .

L = Tell Kief .

L × C = Karonia in Tell kief .

L × P = Z .T . in Tell kief .
C × P = Karonia under Z .T .
L × C × P = Karonia under Z .T . in Tell kief .

Table (18) Effect of planting methods on No. of grains /spike of durum wheat in MRA locations.

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	OM Rabia	17.30 h	14.13 i	12.30 j	14.58 e
	Karonia	18.50 g	17.83 gh	19.97 f	18.76 d
Tellkief	OM Rabia	23.50 de	23.90 d	23.80 d	23.73 c
	Karonia	22.86 e	27.60 b	32.53 a	27.66 a
Bashyqa	OM Rabia	23.90 d	25.43 c	24.86 c	24.73 b
	Karonia	23.40 de	27.50 b	24.10 d	25.00 b
	Sham/5	26.70	27.60	28.36	27.55
					(L)
L x P Interaction	ALHamdania	17.90 f	15.98 g	16.14 g	16.67 c
	Tellkief	23.18 e	25.75 c	28.17 a	25.70 a
	Bashyqa	23.65 e	26.47 b	24.48 d	24.86 b
					(C)
C x P Interaction	OM Rabia	21.57 C	21.15 d	20.32 e	21.01 b
	Karonia	21.59 c	24.31 b	25.53 a	23.81 a
(P)		21.575 b	22.735 a	22.925 a	

C – 5 – Straw Biomass (gm/ m2):

As shown in Table 19 the best results of this trait in factors and interactions are summarized below :
P = Chisel .
C = Karonia and OM Rabia (N . S .) .
L = Tell Kief .
L × C = OM Rabia in Al Hamdania and Karonia in Tell kief .
L × P = Chisel in Tell kief
C × P = Om Rabia under Chisel.
L × C × P = Om Rabia under Chisel In Al-Hamadania.

Table (19) Effect of planting methods on straw biomass(gm/m^2) of durum wheat in MRA locations.

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	OM Rabia	213.65 c	236.23 a	156.63 g	202.17 a
	Karonia	136.06 hi	136.21 hi	137.01 hi	136.42 d
Tellkief	OM Rabia	161.08 g	179.08 d	176.60 de	172.25 b
	Karonia	170.78 ef	220.93 b	207.58 C	199.76 a
Bashyqa	OM Rabia	92.60 l	123.32 j	106.28 K	107.40 e
	Karonia	142.75 h	169.83 f	131.05 I	147.88 c
	Sham/5	155.60	203.08	144.26	167.64
					(L)
L x P Interaction	ALHamdania	174.86 d	186.22 c	146.82 f	121.91 c
	Tellkief	165.93 e	200.00 a	192.09 b	186.00 a
	Bashyqa	117.68 g	146.58 f	118.67 g	175.03 b
					(C)
C x P Interaction	OM Rabia	155.78 c	179.54 a	146.50 d	160.60 a
	Karonia	149.86 d	175.66 b	158.55 c	161.36 a

(P)	152.82 b	177.60 a	152.525 b	

C – 6 – Plant Height (cm) :

As shown in Table (20) the best results of this trait in factors and interactions are summarized below:

P = Chisel
C = Karonia
L = Tell Kief
L × C = Karonia in Tell kief
L × P = Z.T. and Chisel in Tell kief
C × P = Karonia under Chisel
L × C × P = Karonia under Chisel in Tell Kief

Table (20) Effect of planting methods on plant height (cm) of durum wheat in MRA locations.

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	OM Rabia	49.53 i	46.93 i	40.53 j	45.66 f
	Karonia	57.66 gh	60.56 g	56.33 h	58.18 e
Tellkief	OM Rabia	61.26 fg	64.26 ef	71.30 c	65.60 c
	Karonia	77.33 ab	80.83 a	76.93 b	78.36 a
Bashyqa	OM Rabia	66.63 de	68.00 cde	70.13 cd	68.25 b
	Karonia	60.33 g	65.63 e	60.30 g	62.08 d
	Sham/5	61.10	67.00	63.20	63.77
					(L)
L x P Interaction	ALHamdania	53.60 e	53.75 e	48.43 f	51.92 c
	Tellkief	69.30 b	72.55 a	74.12 a	71.99 a
	Bashyqa	63.48 d	66.82 bc	65.22 cd	65.17 b
					(C)

C x P Interaction	OM Rabia	59.14 c	59.73 c	60.65 c	59.84 b
	Karonia	65.11 b	69.01 a	64.52 b	66.21 a
(P)		62.125 b	64.37 a	62.585 b	

C – 7 – Grains Specific Weight (kg/hectoliter) :

As shown in Table (21) the best results of this trait in factors and interactions are summarized below:

P = all planting methods (NS)

C = Karonia

L = Tell Kief

L × C = Karonia in Tell kief

L × P = Chisel in Tell kief

C × P = Karonia under ZT

L × C × P = Karonia under all planting methods in Tell Kief .

Table 21 Effect of planting methods on grains specific weight (kg/hectoliter) of durum wheat in MRA locations.

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALHamdania	OM Rabia	71.7 cd	71.3 cde	69.7 g	70.89 d
	Karonia	74.3 ab	73.7 b	74.7 ab	74.22 b
Tellkief	OM Rabia	71.3 cde	72.3 c	71.0 def	71.55 c
	Karonia	75.0 a	74.3 ab	75.3 a	74.89 a
Bashyqa	OM Rabia	70.0 fg	70.0 fg	71.0 def	70.33 de
	Karonia	70.0 fg	69.7 g	70.3 efg	70.00 e
	Sham/5	69.3	70.3	70.3	69.96
					(L)
L x P Interaction	ALHamdania	73.00 ab	72.50 bc	72.17 c	72.56 b
	Tellkief	73.16 ab	73.33 a	73.16 ab	73.22 a

	Bashyqa	70.00 de	69.83 e	70.66 d	70.17 c
					(C)
C x P Interaction	OM Rabia	71.00 c	71.20 c	70.57 c	70.92 b
	Karonia	73.10 ab	72.57 b	73.43 a	73.03 a
(P)		72.05 a	71.885 a	72.00 a	

3.1.2.1.2d Effect of planting methods on growth and yield traits of barley in MRA locations

D-1-Grains Yield Trait .

D-1-1-grains yield (gm/m2)trait
As shown in Table 22 the best results of this trait in factors and interactions are summarized below:
P = Chisel
C = Rihan/ 3
L = Tellkief
L × C = Rihan in Tellkief
L × P = Chisel in Tellkief
C × P = Rihan under Z.T then Chisel planting methods .
L × C ×P = Rihan under Chisel then Z.T and Con. In Tellkief.

D-1-2-grains Yield (Kg/hectare)Trait:

As shown in Fig. (4) the best results of Grains Yield is 1320 kg/hectarein Rihan/3 under Z.T. and 1260Kg/hectare under Chisel planting method in Tellkief location .

Table (22) Effect of planting methods on grains yield (gm/m^2)of barley in MRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Hamdania	Jazzera	85.05 j	87.72 j	75.35 k	82.70 e
	Rihan	84.22 j	96.98 i	76.97 k	86.05 e
Tell Kief	Jazzera	192.82 cd	194.88 c	187.62 d	191.77 b
	Rihan	202.12 b	209.70 a	196.96 bc	202.93 A

Bashyqa	Jazzera	120.50 g	120.40 g	109.00 h	116.63 D
	Rihan	102.01 i	136.08 f	180.75 e	139.61 C
					(L)
L x P Interaction	Hamdania	84.64 h	92.35 g	76.16 i	84.38 c
	Tellkief	197.47 b	202.29 a	192.29 c	197.35 a
	Bashyqa	111.26 f	128.24 e	144.88 d	128.12 b
					(C)
C x P Interaction	Jazzera	132.79 c	134.33 c	123.99 e	130.37 b
	Rihan	129.45 d	147.59 b	151.56 a	142.87 a
(P)		131.12 c	140.96 a	137.775 b	

D-2-No. of Spikes/m2:

As shown in Table (23) the best results of this trait in factors and interactions are summarized below:

P = Chisel
C = Jazzera
L =Tellkief
L × C = Jazzera in Tellkief.
L × P = Chisel in Tellkief.
C × P = Jazzera under chisel.
L × C ×P = Jazzera under Chisel in Tellkief

Table (23) Effect of planting methods on No. of spikes/m^2 of barley in MRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Hamdania	Jazzera	347.00 f	341.66 f	306.33 h	331.67 c
	Rihan	195.00 l	225.30 j	173.33 m	197.87 e

Tellkief	Jazzera	419.33 b	470.33 a	407.33 c	432.33 a
	Rihan	321.00 G	366.66 d	355.66 e	347.77 b
Bashyqa	Jazzera	237.66 i	243.66 i	202.66 k	227.99 d
	Rihan	194.33 l	203.00 k	199.66 kl	198.99 e
					(l)
L x P Interaction	Hamdania	271.00 e	283.48 d	239.83 f	264.77 b
	Tellkief	370.17 c	418.50 a	381.50 b	390.05 a
	Bashyqa	216.00 h	223.33 g	201.16 i	213.50 c
					(c)
C x P Interaction	Jazzera	334.66 b	351.88 a	305.44 c	330.60 a
	Rihan	236.78 f	264.99 d	242.88 e	248.21 b
(P)		285.72 b	308.435 a	274.16 c	

D-3-Weight of 1000 Grains (gm):

As shown in Table 24 the best results of this trait in factors and interactions are summarized below:

P = Chisel
C = Rihan
L =Tellkief
L × C = Rihan in Tellkief
L × P = Chisel in Tellkief
C × P = Rihan under chisel.
L × C × P = Rihan under chisel In Tellkief.

Table (24) Effect of planting methods on weight of 1000 grains (gm) of barley in MRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction

Hamdania	Jazzera	23.26 e	19.33 f	18.73 f	20.44 e
	Rihan	27.53 c	28.86 c	29.13 c	28.50 c
Tellkief	Jazzera	24.07 de	28.93 c	29.07 c	27.35 d
	Rihan	33.53 b	36.66 a	27.93 c	32.71 a
Bashyqa	Jazzera	35.13 ab	34.00 b	25.60 d	31.58 b
	Rihan	24.25 de	27.80 c	27.75 c	26.60 d
					(L)
L x P Interaction	Hamdania	25.40 e	24.10 f	23.93 f	24.48 c
	Tellkief	28.80 cd	32.80 a	28.50 d	30.03 a
	Bashyqa	29.69 c	30.90 b	26.68 e	29.09 b
					(C)
C x P Interaction	Jazzera	27.49 c	27.42 c	24.47 d	26.46 b
	Rihan	28.44 b	31.11 a	28.27 bc	29.27 a
(P)		27.965 b	29.265 a	26.37 c	

D-4-No. of Grains/spike:

As shown in Table 25 the best results of this trait in factors and interactions are summarized below:

P = all Planting methods (N.S.).

C = Rihan.

L = Tellkief.

L × C = Rihan in Tellkief and Bashyqa locations and Jazzera in Tellkief.

L × P = Z.T. in Tellkief.

C × P = Rihan under Z.T.

L × C ×P = Rihan under Z.T. In Tellkief Location.

Table (25) Effect of planting methods on No. of grains / spike of barley in MRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Hamdania	Jazzera	19.60 ij	21.73 hi	17.60 j	19.64 d
	Rihan	27.40 g	24.96 gh	27.83 g	26.73 c
Tellkief	Jazzera	40.07 b	39.13 b	38.33 bc	39.18 a
	Rihan	37.60 b-e	31.50 f	43.66 a	37.59 a
Bashyqa	Jazzera	34.10 ef	38.00 bcd	34.40 def	35.50 b
	Rihan	37.33 b-e	39.30 b	35.23 cde	37.29 ab
					(L)
L x P Interaction	Hamdania	23.50 c	23.35 c	22.72 c	23.19 c
	Tellkief	38.84 a	35.32 b	41.00 a	38.39 a
	Bashyqa	35.72 b	38.65 a	34.82 b	36.40 b
					(C)
C x P Interaction	Jazzera	31.26 cd	32.95 bc	30.11 d	31.44 b
	Rihan	34.11 ab	31.92 cd	35.57 a	33.87 a
(P)		32.685 a	32.435 a	32.84 a	

D-5-Straw Biomass (gm/m2):

As shown in Table 26 the best results of this trait in factors and interactions are summarized below:

P = Chisel.

C = Rihan.

L =Tellkief.

L × C = Rihan in Tellkief.

L × P = Chisel in Tellkief.

C × P = Rihan under chisel.

L × C ×P = Rihan under Chisel in Tellkief.

Table (26) Effect of planting methods on straw biomass (gm/m^2) of barley in MRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
Hamdania	Jazzera	64.52 L	73.50 k	89.62 i	75.88 f
	Rihan	84.76 ij	91.36 i	81.08 j	85.73 e
Tellkief	Jazzera	115.40 g	123.43 ef	116.05 fg	118.29 c
	Rihan	197.46 b	221.43 a	150.13 c	189.67 a
Bashyqa	Jazzera	107.30 h	117.46 efg	105.14 h	109.97 d
	Rihan	115.05 g	124.10 e	140.23 d	126.46 b
					(L)
L x P Interaction	Hamdania	74.64 g	82.43 f	85.35 f	80.81 c
	Tellkief	156.43 b	172.43 a	133.09 c	153.98 a
	Bashyqa	111.18 e	120.78 d	122.69 d	118.22 b
					(C)
C x P Interaction	Jazzera	95.74 e	104.80 d	103.60 d	101.38 b
	Rihan	132.42 b	145.63 a	123.81 c	133.95 a
(P)		114.08 b	125.215 a	113.705 b	

D-6- Plant Height (cm):

As shown in Table 27 the best results of this trait in factors and interactions are summarized below:

P = Z.T.

C = Rihan.

L =Tellkief.

L × C = Rihan in Tellkief.

L × P = Z.T. in Tellkief.
C × P = Rihan under Z.T.
L × C × P = Rihan under Z.T. in Tellkief location.

Table (27) Effect of planting methods on plant height (cm) of barley in MRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Hamdania	Jazzera	39.60 i	42.23 hi	47.86 fgh	43.23 d
	Rihan	51.83 c-g	47.03 fgh	45.80' gh	48.22 c
Tellkief	Jazzera	55.07 b-e	53.13 c-f	56.43 b-e	54.88 b
	Rihan	56.83 bcd	57.53 bc	67.10 a	60.49 a
Bashyqa	Jazzera	50.63 efg	50.96 d-g	47.93 fgh	49.84 c
	Rihan	59.33 b	52.90 c-f	54.10 b-e	55.44 b
					(L)
L x P Interaction	Hamdania	45.72 d	44.63 d	46.83 d	45.73 c
	Tellkief	55.95 b	55.33 b	61.77 a	57.68 a
	Bashyqa	54.98 b	51.93 bc	51.02 c	52.64 b
					(C)
C x P Interaction	Jazzera	48.43 c	48.77 c	50.74 bc	49.31 b
	Rihan	56.0 a	52.49 b	55.67 a	54.72 a
(P)		52.215 ab	50.63 b	53.205 a	

D-7- Grains Specific Weight (Kg/hectoliter):
As shown in Table 28 the best results of this trait in factors and interactions are summarized below:
P =Z.T.

C = Jazzera
L =Tellkief
L × C = Jazzera in Tellkief
L × P = all planting methods in Telkief .
C × P = Jazzera under all planting methods.
L × C ×P = Jazzera under all planting methods in Tellkief.

Table 28 Effect of planting methods on plant grains specific weight (Kg / hectoliter) of barley in MRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Hamdania	Jazzera	52.3 d	52.0 d	52.3 d	52.22 c
	Rihan	48.3 g	45.7 h	48.3 g	47.43 e
Tellkief	Jazzera	58.7 a	58.0 a	58.3 a	58.33 a
	Rihan	53.3 c	54.3 b	53.7 bc	53.76 b
Bashyqa	Jazzera	48.7 fg	50.7 e	49.3 f	49.56 d
	Rihan	38.3 j	41.0 i	45.0 h	41.43 f
					(L)
L x P Interaction	Hamdania	50.33 b	48.83 c	50.33 b	49.83 b
	Tellkief	56.00 a	56.17 a	56.00 a	56.05 a
	Bashyqa	43.50 f	45.83 e	47.17 d	45.50 c
					(C)
C x P Interaction	Jazzera	53.23 a	53.57 a	53.30 a	53.37 a
	Rihan	46.66 c	47.00 c	49.00 b	47.54 b
(P)		49.93 b	50.285 b	51.15 a	

3.1.2.1.2e Effect of planting methods on growth and yield traits of bread wheat in HRA locations

E-1-Grains Yield trait:

E-1-1-grains yield (gm/m2) trait:
As shown in table 29 the best results of this trait in factors and interactions are summarized below:
P = Chisel
C = Abo Ghariab and Sham/6 (N.S.)
L = Alqush
L X C = Sham / 6 in Alqush
L X P = Chisel in Alqush
C X P = Sham / 6 under Chisel
L X C X P = Sham / 6 under Chisel in Alqush

E-1-2-grains yield (kg/hectare) trait :
As shown in Fig 5 the best results of grains yield is 2156 kg/ha in Sham/6 under Chisel in Alqush location then 2051 kg/ha in Abo Ghariab/3 under Z.T. in Al Shiykhan location.

Table (29) Effect of planting methods on grains yield (gm/m^2) of bread wheat in HRA locations

Location (L)	Planting Method (C) (P) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Rabiaa	Abo Ghariab	128.90 k	139. 60 j	137. 40 j	135. 3 e
	Sham/6	104. 16 m	119. 20 l	116. 16 l	113. 17 f
Shykhan	Abo Ghariab	191. 31 h	206. 30 e	227. 20 cd	208. 27 c
	Sham/6	208. 68 e	202. 21 ef	198. 30 fg	203. 06 d
Alqush	Abo Ghariab	223. 78 d	244. 90 b	173. 78 i	214. 15 b
	Sham/6	233.48 c	285. 53 a	195. 08 gh	238. 03 a
	Sham/4	217.15	230.01	177.10	208.08
					(L)
	Rabiaa	116.53 g	129.40 f	126.78 f	124.24 c

L x P Interaction	Shykhan	200.00 d	204.26 d	212.75 c	205.67 b
	Alqush	228.63 b	265.22 a	184.43 e	226.09 a
					(C)
C x P Interaction	Abo Ghariab	181.33 c	196.93 b	179.46 c	185.91 a
	Sham/6	182.11 c	202.31 a	169.85 d	184.73 a
(P)		181.72 b	199.58 a	174.65 c	

E-2-No. of Spikes / m2 :

As shown in table 30 the best results of this trait in factors and interactions are summarized below :

P = Chisel.

C = Sham/6.

L = Alqush.

L X C = Abo Ghariab then Sham/6 in Alqush.

L X P = Chisel in Alqush.

C X P = Sham/6 and Abo Ghariab under Chisel.

L X C X P = Abo Ghariab under Chisel in Alqush location.

Table (30) Effect of planting methods on No. of spikes /m^2 of bread wheat in HRA locations

Location (L)	Planting Method (C) (P) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Rabiaa	Abo Ghariab	288.00 l	392.66 h	356.33 j	345.66 f
	Sham/6	316.33 k	404.33 g	357.00 j	359.22 e
Shykhan	Abo Ghariab	319.60 k	375.33 i	451.00 cd	381.97 d
	Sham/6	423.00 e	419.30 ef	415.00 f	419.10 c
Alqush	Abo Ghariab	472.33 b	498.33 a	444.60 d	471.75 a
	Sham/6	447.00 cd	453.00 c	444.00 d	448.00 b
	Sham/4	435.00	505.66	324.33	421.66

					(l)
L x P Interaction	Rabiaa	302.17 h	398.50 e	356.67 g	352.45 c
	Shykhan	371.30 f	397.32 e	433.00 d	400.54 b
	Alqush	459.67 b	475.67 a	444.30 c	459.88 a
	(c)				
C x P Interaction	Abo Ghariab	359.98 e	422.11 a	417.31 b	399.80 b
	Sham/6	395.44 d	425.54 a	405.33 c	408.77 a
(P)		377.71 c	423.82 a	411.32 b	

E-3-weight of 1000 grains (gm) :

As shown in table 31 the best results of this trait in factors and interactions are summarized below :

P = Z.T.

C = Abo Ghariab.

L = Rabiaa.

L X C = Abo Ghariab in Rabiaa.

L X P = Z.T. in Rabiaa.

C X P = Abo Ghariab and Sham/6 under Z.T.

L X C X P = Abo Ghariab under Z.T. in Rabiaa.

Table (31) Effect of planting methods on Weight of 1000 grains (gm) of bread wheat in HRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Rabiaa	Abo Ghariab	27.20 c	31.00 b	32.80 a	30.33 a
	Sham/6	21.40 ef	30.47 b	29.55 b	27.14 b
Shykhan	Abo Ghariab	26.66 c	24.33 d	26.00 c	25.66 c
	Sham/6	27.53 c	23.93 d	26.86 c	26.10 c

Alqush	Abo Ghariab	20.73 ef	18.66 g	21.53 ef	20.30 d
	Sham/6	20.60 ef	19.90 fg	21.73 e	20.74 d
	Sham/4	22.33	20.60	20.80	21.24
					(L)
L x P Interaction	Rabiaa	24.30 c	30.74 a	31.18 a	28.74 a
	Shykhan	27.10 b	24.13 c	26.43 b	25.87 b
	Alqush	20.66 d	19.28 e	21.63 d	20.52 c
					(C)
C x P Interaction	Abo Ghariab	24.86 b	24.66 b	26.78 a	25.43 a
	Sham/6	23.18 c	24.77 b	26.05 a	24.67 b
(P)		24.02 c	24.71 b	26.415 a	

E-4-No. Grains / Spike :

As shown in table 32 the best results of this trait in factors and interactions are summarized below :
P = Z.T. and Chisel.
C = Abo Ghariab.
L = Alqush.
L X C = Abo Ghariab then Sham/6 in Alqush.
L X P = All planting methods in Alqush.
C X P = Abo Ghariab under Z.T. and Chisel.
L X C X P = Abo Ghariab under Chisel in Alqush location

Table (32) Effect of planting methods on No. of grains/spike of bread wheat in HRA locations .

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction

Rabiaa	Abo Ghariab	27.56 f	30.36 de	35.86 b	31.26 c
	Sham/6	26.90 f	28.93 ef	27.40 f	27.74 e
Shykhan	Abo Ghariab	31.30 cd	30.23 de	28.40 ef	29.98 d
	Sham/6	21.53 g	23.13 g	27.36 f	24.006 f
Alqush	Abo Ghariab	36.20 b	39.57 a	36.77 b	37.51 a
	Sham/6	32.73 c	32.40 cd	33.63 c	32.92 b
	Sham/4	32.66	33.10	33.03	32.93
					(L)
L x P Interaction	Rabiaa	27.23 d	29.65 c	31.63 b	29.50 b
	Shykhan	26.42 d	26.68 d	27.88 d	26.99 c
	Alqush	34.47 a	35.99 a	35.20 a	35.22 a
					(C)
C x P Interaction	Abo Ghariab	31.69 b	33.39 a	33.68 a	32.92 a
	Sham/6	27.05 d	28.15 d	29.46 c	28.22 b
(P)		29.37 b	30.77 a	31.57 a	

E-5-Straw Biomass (gm/m2) :

As shown in table 33 the best results of this trait in factors and interactions are summarized below:
P = Chisel.
C = Sham/6.
L = Rabiaa.
L X C = Abo Ghariab in Rabiaa.
L X P = Chisel in Rabiaa.
C X P = Sham/6 under Chisel.
L X C X P = Abo Ghariab under Chisel and Z.T. and Sham/6 under Chisel in Rabiaa.

Table (33) Effect of planting methods on straw biomass (gm/m^2) of bread wheat in HRA locations .

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
Rabiaa	Abo Ghariab	225.91 d	257.74 a	253.74 a	254.88 a
	Sham/6	215.64 e	255.02 a	246.24 b	238.97 b
Shykhan	Abo Ghariab	144.43 i	173.60 h	209.78 ef	175.94 e
	Sham/6	244.10 b	206.71 fg	208.70 f	219.84 c
Alqush	Abo Ghariab	201.42 g	169.04 h	136.83 j	169.10 f
	Sham/6	228.32 cd	232.66 c	144.57 i	201.85 d
	Sham/4	159.37	169.69	129.39	152.82
					(L)
L x P Interaction	Rabiaa	220.78 c	256.38 a	250.11 b	242.42 a
	Shykhan	194.27 g	190.16 g	209.24 e	197.89 b
	Alqush	214.87 d	200.85 f	140.70 h	185.47 c
					(C)
C x P Interaction	Abo Ghariab	19059 c	200.13 b	200.20 b	196.97 b
	Sham/6	229.35 a	231.46 a	199.83 b	220.21 a
(P)		209.97 b	215.97 a	200.015 c	

E-6-Plant Height (cm) :

As shown in table 34 the best results of this trait in factors and interactions are summarized below:
P = Chisel.

C = Abo Ghariab.
L = Rabiaa .
L X C = Abo Ghariab in Rabiaa.
L X P = Chisel in Rabiaa.
C X P = Abo Ghariab under all planting methods
L X C X P = Abo Ghariab under Chisel in Rabiaa location.

Table (34) Effect of planting methods on Plant height (cm) of bread wheat in HRA locations .

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Rabiaa	Abo Ghariab	68.00 ab	68.90 A	68.36 ab	68.42 a
	Sham/6	59.10 efg	67.20 abc	64.73 a-d	63.67 bc
Shykhan	Abo Ghariab	64.03 a-e	63.10 b-f	59.20 efg	62.11 cd
	Sham/6	57.80 fg	60.46 def	62.30 c-f	60.18 d
Alqush	Abo Ghariab	67.73 abc	63.00 b-f	64.46 a-e	65.06 b
	Sham/6	60.20 def	63.90 a-e	54.50 g	59.53 d
	Sham/4	54.46	55.63	60.96	57.01
					(L)
L x P Interaction	Rabiaa	63.55 bc	68.05 a	66.55 ab	66.05 a
	Shykhan	60.92 cd	61.78 cd	60.75 cd	61.15 b
	Alqush	63.97 bc	63.45 bc	59.48 d	62.30 b
					(C)
C x P Interaction	Abo Ghariab	66.59 a	65.00 a	64.01 a	65.20 a
	Sham/6	59.03 b	63.85 a	60.51 b	61.13 b

(P)	62.81 ab	64.42 a	62.26 b	

E-7-Grains Specific Weight (kg/hecoliter) :

As shown in table 35 the best results of this trait in factors and interactions are summarized below:
P = Chisel.
C = Abo Ghariab.
L = Shykhan.
L X C = Abo Ghariab in Shykhan.
L X P = Chisel in Shykhan.
C X P = Abo Ghariab and Sham/6 under Chisel.
L X C X P = Abo Ghariab and Sham/6 under Chisel and Abo Ghariab under Z.T. (N.S.) in Shykhan

Table (35) Effect of planting methods on grains Specific Weight (kg/hectoliter) of bread wheat in HRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
Rabiaa	Abo Ghariab	66.0 e	65.7 e	66.0 e	65.88 d
	Sham/6	68.0 d	68.0 d	66.0 e	67.33 c
Shykhan	Abo Ghariab	71.0 bc	74.0 a	73.3 a	72.78 a
	Sham/6	71.0 bc	73.3 a	71.3 b	71.88 b
Alqush	Abo Ghariab	63.0 g	70.3 c	64.1 f	65.80 d
	Sham/6	64.0 f	68.0 d	60.7 h	64.23 e
	Sham/4	67.0	64.0	64.3	65.1
					(L)
L x P Interaction	Rabiaa	67.00 e	66.85 e	66.00 f	66.61 b
	Shykhan	71.00 c	73.65 a	72.30 b	72.32 a

	Alqush	63.50 g	69.15 d	62.40 h	65.01 c
					(C)
C x P Interaction	Abo Ghariab	66.67 c	70.00 a	67.78 b	68.15 a
	Sham/6	67.67 b	69.77 a	66.00 d	67.81 b
(P)		67.17 b	69.88 a	66.90 b	

3.1.2.1.2f Effect of planting methods on growth and yield traits of durum wheat in HRA locations

F-1-Grains Yield trait :

F-1-1 grains yield (gm/m2) trait:
As shown in table 36 the best results of grains yield (gm/m2) in factors and interactions are summarized below:
P = Chisel.
C = Karonia.
L = Alqush.
L X C = Karonia in Alqush.
L X P = Chisel in Alqush.
C X P = Karonia under Chisel.
L X C X P = Karonia under Chisel in Alqush.

F-1-2-Grains yield (kg/hectar) trait :
As shown in fig (6) the best results of grain yield is 2550 kg/ha in Karonia under Chisel planting method in Alqush location then 1928 kg/ha in Sham / 3 under Z.T. in Al Shykhan location

Table (36) Effect of planting methods on grains yield (gm/m^2) of durum wheat in HRA locations

Location (L)	Planting Method (C) (P) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Alqush	Sham/3	185.13 g	239.86 c	221.25 e	215.41 c
	Karonia	286.48 b	360.91 a	177.74 h	275.04 a
Rabiaa	Sham/3	70.41 o	121.45 l	106.26 m	99.37 f

	Karonia	88.46 n	133.90 k	146.16 j	122.84 e
Shykhan	Sham/3	205.00 f	219.16 e	233.18 d	219.11 b
	Karonia	150.93 ij	154.45 i	173.15 h	159.51 d
					(L)
L x P Interaction	Alqush	235.81 b	300.39 a	199.50 c	245.23 a
	Rabiaa	79.44 g	127.68 f	126.21 f	111.11 c
	Shykhan	177.97 e	186.81 d	203.17 c	189.31 b
					(C)
C x P Interaction	Sham/3	153.51 f	193.49 b	186.89 c	177.96 b
	Karonia	175.29 d	216.42 a	165.68 e	185.79 a
(P)		164.40 c	204.95 a	176.29 b	

F-2- No. of Spikes :

As shown in Table 37 the best results of this trait in factors and interactions are summarized below:
P = Chisel.
C = Karonia.
L = Alqush.
L X C = Karonia in Alqush.
L X P = Con. then Chisel in Alqush.
C X P = Karonia under Con. planting methods.
L X C X P = Karonia under Con. then Chisel planting methods in Alqush.

Table 37 Effect of planting methods on No. of spikes/m^2 of durum wheat in HRA locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction

Alqush	Sham/3	408.00 d	398.00 e	467.00 c	424.33 b
	Karonia	601.33 a	533.50 b	223.00 kL	452.61 a
Rabiaa	Sham/3	136.33 p	226.33 k	216.66 Lm	193.10 e
	Karonia	169.00 O	197.00 n	215.00 m	193.66 e
Shykhan	Sham/3	229.30 k	323.66 h	342.33 g	298.43 d
	Karonia	315.60 i	278.00 j	368.00 f	320.53 c
					(L)
L x P Interaction	Alqush	504.67 a	465.75 b	345.00 d	438.47 a
	Rabiaa	152.67 h	211.67 g	215.83 g	193.39 c
	Shykhan	272.45 f	300.83 e	355.17 c	309.48 b
					(C)
C x P Interaction	Sham/3	257.88 f	316.00 d	342.00 b	305.29 b
	Karonia	361.98 a	336.17 c	268.67 e	322.27 a
(P)		309.93 b	326.08 a	305.33 c	

F-3-Weight of 1000 Grains (gm) :

As shown in table 38 the best results of this trait in factors and interactions are summarized below:

P = Chisel.

C = Karonia.

L = Sykhan.

L X C = Karonia in Rabiaa and Shykhan.

L X P = Chisel in Sykhan.

C X P = Karonia under Chisel.

L X C X P = Karonia under Chisel in Alqush and Shykhan.

Table 38 Effect of planting methods on weight of 1000 grains (gm) of durum wheat in HRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
Alqush	Sham/3	21.86 e	25.13 de	25.06 de	24.016 c
	Karonia	26.00 de	35.26 a	27.73 cd	29.66 b
Rabiaa	Sham/3	25.13 de	22.60 e	22.40 e	23.37 c
	Karonia	33.15 ab	32.42 ab	32.90 ab	32.82 a
Shykhan	Sham/3	32.06 ab	32.86 ab	29.93 bc	31.61 ab
	Karonia	32.54 ab	34.46 a	31.46 abc	32.81 a
					(L)
L x P Interaction	Alqush	23.93 f	30.20 bcd	26.40 ef	26.84 b
	Rabiaa	29.14 cde	27.51 de	27.65 de	28.10 b
	Shykhan	32.30 ab	33.66 a	30.70 bc	32.22 a
					(C)
C x P Interaction	Sham/3	26.35 c	26.86 c	25.80 c	26.33 b
	Karonia	30.56 b	34.05 a	30.70 b	31.77 a
(P)		28.45 b	30.45 a	28.25 b	

F-4-No. of Grains/Spike :

As shown in Table 39 the best results of this trait in factors and interactions are summarized below:

P = Chisel.

C = Sham / 3.

L = Alqush.
L X C = Sham / 3 in Alqush.
L X P = Chisel in Alqush.
C X P = Sham / 3 under Con. planting methods.
L X C X P = Sham / 3 under Chisel and Con. Planting methods in Alqush.

Table 39 Effect of planting methods on No. of grains/spike of durum wheat in HRA locations.

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
Alqush	Sham/3	35.60 a	36.97 a	32.23 b	34.93 a
	Karonia	27.23 cd	31.07 b	32.66 b	30.32 c
Rabiaa	Sham/3	29.10 c	27.27 cd	32.50 b	29.62 c
	Karonia	26.80 d	28.87 c	26.60 d	27.42 d
Shykhan	Sham/3	36.53 a	31.90 b	31.90 b	33.44 b
	Karonia	23.26 e	29.10 c	23.90 e	25.42 e
					(L)
L x P Interaction	Alqush	31.42 bc	34.02 a	32.45 b	32.63 a
	Rabiaa	27.95 e	28.07 e	29.55 d	28.59 c
	Shykhan	29.90 d	30.50 cd	27.90 e	29.43 b
					(C)
C x P Interaction	Sham/3	33.74 a	32.05 b	32.21 b	32.66 a
	Karonia	25.76 e	29.68 c	27.72 d	27.72 b
(P)		29.75 b	30.86 a	29.96 b	

F-5- Straw Biomass (gm/m2) :

As shown in table 40 the best results of this trait in factors and interactions are summarized below:

P = Chisel.
C = Karonia.
L = Alqush.
L X C = Karonia in Alqush.
L X P = Chisel in Alqush.
C X P = Karonia under Chisel
L X C X P = Karonia under Chisel in Alqush.

Table 40 Effect of planting methods on straw biomass (gm/m^2) of durum wheat in HRA locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
Alqush	Sham/3	182.49 hi	250.41 d	187.56 h	206.82 c
	Karonia	336.89 b	481.93 a	231.85 e	350.22 a
Rabiaa	Sham/3	107.68 n	170.69 k	131.05 m	136.47 e
	Karonia	177.53 ij	227.03 e	260.09 c	221.55 b
Shykhan	Sham/3	159.35 L	182.35 hi	211.95 f	184.55 d
	Karonia	177.46 ij	173.40 jk	204.11 g	184.99 d
					(L)
L x P Interaction	Alqush	259.69 b	366.17 a	209.71 c	278.52 a
	Rabiaa	142.61 g	198.86 d	195.57 d	179.01 c
	Shykhan	168.41 f	177.88 e	208.03 c	184.77 b
					(C)
C x P Interaction	Sham/3	149.84 e	201.15 c	176.85 d	175.94 b
	Karonia	230.63 b	294.12 a	232.02 b	252.25 a

(P)	190.23 c	247.68 a	204.43 b	

F-6-Plant Height (cm) :

As shown in table 41 the best results of this trait in factors and interactions are summarized below:

P = Chisel.
C = Karonia.
L = Alqush.
L X C = Karonia in Alqush.
L X P = Chisel in Alqush.
C X P = Karonia under Chisel.
L X C X P = Karonia under Chisel in Alqush.

Table (41) Effect of planting methods on plant height (cm) of durum wheat in HRA locations

Location (L)	Planting Method (P) / Cultivars (P)	Con.	Chisel	Z.T.	L x C interaction
Alqush	Sham/3	66.33 fg	75.00 d	70.90 e	70.74 c
	Karonia	87.13 c	107.30 a	91.70 b	95.37 a
Rabiaa	Sham/3	68.56 ef	63.83 g	68.90 ef	67.09 e
	Karonia	92.60 b	93.63 b	93.10 b	93.11 b
Shykhan	Sham/3	70.13 ef	68.83 ef	69.40 ef	69.45 cd
	Karonia	66.60 efg	69.76 ef	66.36 fg	67.57 de
					(L)
L x P Interaction	Alqush	76.73 c	91.15 a	81.30 b	83.06 a
	Rabiaa	80.58 b	78.73 bc	81.00 b	80.10 b
	Shykhan	68.37 d	69.30 d	67.88 d	68.51 c
					(C)

C x P Interaction	Sham/3	68.34 c	69.22 c	69.73 c	69.09 b
	Karonia	82.11 b	90.23 a	81.00 b	85.35 a
(P)		75.22 b	79.72 a	67.88 b	

F-7-Grains Specific Weight (kg/hectoliter) :

As shown in table 42 the best results of this trait in factors and interactions are summarized below:

P = Chisel.

C = Karonia.

L = Sykhan.

L X C = Karonia in Sykhan and Rabiaa locations.

L X P = Con. and Z.T. in Sykhan.

C X P = Karonia under Chisel.

L X C X P = Karonia under Chisel in Alqush.

Table (42) Effect of planting methods on grains specific weight (kg/hectoliter) in HRA locations

Location (L)	Planting Method (P) / Cultivars (P)	Con.	Chisel	Z.T.	L x C interaction
Alqush	Sham/3	66.7 f	66.7 f	67.3 f	66.90 d
	Karonia	64.7 g	75.3 a	66.7 f	68.90 c
Rabiaa	Sham/3	73.0 bc	73.0 bc	69.0 e	71.67 b
	Karonia	72.0 cd	72.0 cd	73.0 bc	72.33 a
Shykhan	Sham/3	73.3 b	68.3 e	75.0 a	72.22 a
	Karonia	74.0 b	73.0 bc	71.3 d	72.80 a
					(L)
L x P Interaction	Alqush	65.67 e	71.00 c	67.00 d	67.89 c
	Rabiaa	72.50 b	72.50 b	71.00 c	72.00 b

	Shykhan	73.65 a	70.66 c	73.16 ab	72.48 a
					(C)
C x P Interaction	Sham/3	71.00 b	69.33 d	70.44 c	70.25 b
	Karonia	70.23 c	73.44 a	70.33 c	71.33 a
(P)		70.61 b	71.38 a	70.38 b	

3.1.2.1.2g Effect of planting methods on growth and yield traits of bread wheat in SI locations

G-1-Grains yield trait:

G-1-1-Grains yield (gm/m2) trait:
As shown in Table 43 the best results of this trait in factors and interactions are summarized below:
P= Z.T.
C = Tell Affer.
L = Rabiaa.
L X C = Adnania in Rabiaa location.
L X P = Chisel in Rabiaa location.
C X P = Tell Affer under Z.T.
L X C X P = Adnania under Chisel in Rabiaa location.

G-1-2- Grains yield (kg/hectar) trait :
As shown in Fig (7) the best results of grains yield is(1720kg/hec.) in Adnania under Chisel plating method in Rabiaa location , then (1298 kg/hec.) and (1218 kg/ hec.) in Adnania and Tell Affer cultivars under Z.T. planting method in Hamidat location .

Table (43) Effect of planting methods on grains yield (gm/m^2) of bread wheat in SI locations

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Tell Affer/3	118.76 i	75.06 L	87.02 k	93.61 e
	Adnania	40.22 n	58.75 m	75.70 L	58.22 f
Rabiaa	Tell Affer/3	193.78 f	231.05 b	203.65 e	209.49 b

	Adnania	223.63 c	240.26 a	235.25 ab	233.04 a
Hamidat	Tell Affer/3	99.02 j	131.76 h	214.15 d	148.31 c
	Adnania	76.92 L	117.65 i	153.58 g	116.05 d
					(L)
L x P Interaction	ALNamroud	79.49 g	66.91 h	81.36 g	75.92 c
	Rabiaa	208.71 c	235.66 a	219.45 b	221.27 a
	Hamidat	87.97 f	124.71 e	183.87 d	132.18 b
					(C)
C x P Interaction	Tell Affer/3	137.19 d	145.96 c	168.27 a	150.47 a
	Adnania	113.59 e	138.89 d	154.84 b	135.77 b
(P)		125.39 c	142.42 b	161.55 a	

G-2-N0. of Spikes/ m2:

As shown in Table 44 the best results of this trait in factors and interactions are summarized below:

P = Z.T.

C = Tell Affer.

L = Rabiaa.

L X C = Tell Affer then Adnania in Rabiaa location .

L X P = Chisel in Rabiaa location.

C X P = Tell Affer under Z.T.

L X C X P = Tell Affer under Z.T and Chisel then Adnania in Rabiaa location .

Table (44) Effect of planting methods on No. of spikes/m^2 of bread wheat in SI locations

Location (L)	Planting Method (C) / (P) Cultivars	Con.	Chisel	Z.T.	L x C interaction

ALNamroud	Tell Affer/3	209.66 g	148.33 k	175.66 hi	177.88 e
	Adnania	140.00 L	171.00 i	255.66 c	188.88 d
Rabiaa	Tell Affer/3	335.66 b	352.66 a	354.00 a	347.44 a
	Adnania	236.00 f	340.66 b	250.00 d	275.55 b
Hamidat	Tell Affer/3	162.66 j	181.33 h	243.30 e	195.76 c
	Adnania	138.00 L	147.33 k	177.33 h	154.22 f
					(L)
L x P Interaction	ALNamroud	174.83 f	159.67 h	215.66 d	183.39 b
	Rabiaa	285.83 c	346.66 a	302.00 b	311.49 a
	Hamidat	150.33 i	164.33 g	210.32 e	174.99 c
					(C)
C x P Interaction	Tell Affer/3	235.99 b	227.44 c	257.65 a	240.36 a
	Adnania	171.33 e	219.66 d	227.66 c	260.21 b
(P)		203.66 c	223.55 b	242.65 a	

G-3- Weight of 1000 Grains (gm) :

As shown in Table 45 the best results of this trait in factors and interactions are summarized below:

P = All planting method (NS)

C = Tell Affer and Adnania (NS)

L = Rabiaa

L X C = Tell Affer and Adnania in Rabiaa location .

L X P = Chisel in Rabiaa location .

C X P = No significant differences between all treatments .

L X C X P = Tell Affer and Adnania under Chisel in Rabiaa location .

Table (45) Effect of planting methods on weight of 1000 grains (gm) of bread wheat in SI locations .

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Tell Affer/3	28.66 d-g	25.64 ghi	28.62 efg	27.46 c
	Adnania	23.93 hi	22.60 i	23.80 hi	23.44 d
Rabiaa	Tell Affer/3	32.07 abc	34.38 a	32.47 abc	32.97 a
	Adnania	32.82 ab	32.90 ab	30.88 b-e	32.20 a
Hamidat	Tell Affer/3	25.73 ghi	27.13 fgh	28.13 efg	26.99 c
	Adnania	29.60 b-f	31.93 a-d	29.13 c-f	30.22 b
					(L)
L x P Interaction	ALNamroud	26.30 c	24.03 d	26.03 cd	25.45 c
	Rabiaa	32.45 a	33.64 a	31.68 a	32.59 a
	Hamidat	27.67 bc	29.53 b	28.63 b	28.61 b
					(C)
C x P Interaction	Tell Affer/3	28.82 a	28.99 a	29.62 a	29.14 a
	Adnania	28.78 a	29.14 a	27.94 a	28.62 a
(P)		28.80 a	29.065 a	28.78 a	

G-4-No. of Grains / Spikes :

As shown in Table 46 the best results of this trait in factors and interactions are summarized below:

P = Chisel and Z.T.

C = Tell Affer .

L = Hamidat .

L X C = Adnania in Hamidat location.

L X P = Z.T and chisel in Hamidat location.

C X P = Tell Afer under Con. planting method.

L X C X P = Adnania under Z.T. in Hamidat location

Table (46) Effect of planting methods on No. of grains /spike of bread wheat in SI locations .

Location (L)	Planting Method (P) / Cultivars (P)	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Tell Affer/3	28.97 ef	22.37 g	20.43 h	23.92 e
	Adnania	14.90 i	23.50 g	20.43 h	19.61 f
Rabiaa	Tell Affer/3	33.50 c	31.50 d	33.50 c	32.83 c
	Adnania	28.43 f	30.53 de	29.70 def	29.55 d
Hamidat	Tell Affer/3	33.73 c	36.96 ab	36.83 ab	35.84 b
	Adnania	36.30 b	37.43 ab	38.76 a	37.49 a
					(L)
L x P Interaction	ALNamroud	21.94 d	22.94 d	20.43 e	21.77 c
	Rabiaa	30.97 c	31.02 c	31.60 c	31.20 b
	Hamidat	35.02 b	37.20 a	37.80 a	36.67 a
					(C)
C x P Interaction	Tell Affer/3	32.07 a	30.28 b	30.25 b	30.86 a
	Adnania	26.54 c	30.49 b	29.63 b	28.88 b
(P)		29.30 b	30.38 a	29.94 ab	

G-5- Straw Biomass (gm/m2) :

As shown in Table 47 the best results of this trait in factors and interactions are summarized below:

P = Z.T

C = Tell Affer

L = Rabiaa location .
L X C = Tell Affer in Rabiaa location .
L X P = Chisel then Z.T in Rabiaa location.
C X P =Tell Affer under Z.T planting method
L X C X P = Tell Affer and Adnania under Chisel in Rabiaa location.

Table (47) Effect of planting methods on straw biomass (gm/m^2) of bread wheat in SI locations .

Location (L)	Planting Method (P) / Cultivars (P)	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Tell Affer/3	145.17 f	84.32 j	92.73 i	107.40 e
	Adnania	56.76 L	54.12 L	79.21 k	63.36 f
Rabiaa	Tell Affer/3	383.55 c	532.63 a	474.73 b	463.63 a
	Adnania	381.33 c	535.20 a	384.15 c	433.56 b
Hamidat	Tell Affer/3	98.90 h	124.00 g	272.85 d	165.25 c
	Adnania	87.06 j	123.72 g	165.00 e	125.26 d
					(L)
L x P Interaction	ALNamroud	100.96 f	69.22 i	85.97 h	85.38 c
	Rabiaa	382.44 c	533.92 a	429.44 b	448.60 a
	Hamidat	92.98 g	123.86 e	218.93 d	145.25 b
					(C)
C x P Interaction	Tell Affer/3	209.21 d	246.98 b	280.10 a	245.43 a
	Adnania	175.05 e	237.68 c	209.45 d	207.39 b
(P)		192.13 c	242.33 b	244.77 a	

G-6- Plant Height (cm):

As shown in Table 48 the best results of this trait in factors and interactions are summarized below:

P = ZT

C = Tell Affer and Adnania (NS)

L = Rabiaa

L X C = Adnania in Rabiaa location .

L X P = ZT in Rabiaa location

C X P = Adnania and Tell Affer under ZT

L X C X P = Adnania under ZT in Rabiaa location

Table (48) Effect of planting methods on plant height (cm) of bread wheat in SI locations .

Location (L)	Planting Method (P) / Cultivars (P)	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Tell Affer/3	63.87 fg	61.00 g	51.83 h	58.90 d
	Adnania	39.76 i	53.70 h	53.96 h	49.14 e
Rabiaa	Tell Affer/3	86.03 cd	85.83 cd	90.36 c	87.40 b
	Adnania	94.83 b	89.46 c	100.37 a	94.88 a
Hamidat	Tell Affer/3	60.30 g	65.03 fg	83.63 d	69.65 c
	Adnania	64.63 fg	67.43 f	72.43 e	68.16 c
					(L)
L x P Interaction	ALNamroud	51.82 g	57.35 f	52.90 g	54.02 c
	Rabiaa	90.43 b	87.65 b	95.37 a	91.15 a
	Hamidat	62.47 e	66.23 d	78.03 c	68.91 b
					(C)
C x P Interaction	Tell Affer/3	70.07 b	70.62 b	75.27 a	71.98 a
	Adnania	66.41 c	70.20 b	75.59 a	70.73 a

(P)	68.24 c	70.41 b	75.43 a	

G-7-Grains Specific Weight (kg/hectoliter):

As shown in Table (49) the best result of this trait in factors and interactions are summarized below:

P = ZT

C = Tell Affer

L = Hamidat

L X C = Adnania in Rabiaa location

L X P = Z.T in Hamidat location

C X P = Tell Affer under ZT

L X C X P = Adnania under Z.T in Hamidat location.

Table (49) Effect of planting methods on grains specific weight (kg/hectoliter) of bread wheat in SI locations .

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Tell Affer/3	72.6 c	71.0 de	71.3 de	71.66 b
	Adnania	59.6 i	56.3 j	60.0 i	58.66 e
Rabiaa	Tell Affer/3	69.0 f	68.0 g	68.3 fg	68.43 d
	Adnania	68.3 fg	68.7 fg	68.7 fg	68.56 d
Hamidat	Tell Affer/3	71.7 d	66.0 h	73.7 b	70.44 c
	Adnania	70.7 e	70.7 e	75.3 a	72.22 a
					(L)
L x P Interaction	ALNamroud	66.17 d	63.65 e	65.65 d	65.13 c
	Rabiaa	68.65 c	68.35 c	68.50 c	68.50 b
	Hamidat	71.17 b	68.33 c	74.50 a	71.28 a

					(C)
C x P Interaction	Tell Affer/3	71.11 a	68.33 b	71.11 a	70.18 a
	Adnania	66.22 c	65.10 d	68.00 b	66.48 b
(P)		68.65 b	66.72 c	69.55 a	

3.1.2.1.2h Effect of planting methods on growth and yield traits of durum wheat in SI locations

H-1-Grains yield trait:

H-1-1-Grains yield (gm/m2) trait:
As shown in table 50 the best results of this trait in factors and interactions are summarized below:
P = Z.T.
C = Sham/3
L = Rabiaa location
L X C = Om Rabiaa cultivar in Rabiaa location
L X P = chisel in Rabiaa location
C X P = Sham/3 and Om Rabiaa under ZT
L X C X P = Om Rabiaa under Chisel and ZT in Rabiaa then Sham/3 under ZT in Hamidat

H-1-2-Grains yield (kg/hectar) trait:
As shown in Fig.8 the best result of grains yield is1760 kg/ha in Sham/3 under Z.T. planting method in Hamidat and 1720 kg/ha in Om Rabiaa under both ZT and Chisel planting method in Rabiaa

Table (50) Effect of planting methods on grains yield (gm/m^2) of durum wheat in SI locations .

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Sham/3	133.50 h	134.73 h	109.96 j	126.06 e
	Om Rabiaa	31.50 n	54.10 m	63.50 L	49.70 f
Rabiaa	Sham/3	208.78 d	261.20 b	188.15 e	219.37 b
	Om Rabiaa	156.75 f	276.50 a	274.45 a	235.9 a

Hamidat	Sham/3	87.25 k	150.08 g	262.68 b	166.67 d
	Om Rabiaa	115.90 i	218.12 c	220.06 c	184.69 c
					(L)
L x P Interaction	ALNamroud	82.50 h	94.42 f	86.73 g	87.88 c
	Rabiaa	182.77 d	268.85 a	231.3 c	227.64 a
	Hamidat	101.58 e	184.10 d	241.37 b	175.68 b
					(C)
C x P Interaction	Sham/3	143.18 c	182.00 b	186.93 a	170.70 a
	Om Rabiaa	101.38 d	182.91 b	186.00 a	156.76 b
(P)		122.28 c	182.45 b	186.46 a	

H-2-No. of Spikes/ m2:

As shown in table 51) the best results of this trait in factors and interactions are summarized below:

P = Chisel

C = Om Rabiaa

L = Rabiaa location

L X C = Om Rabiaa in Rabiaa location

L X P = Chisel in Rabiaa location

C X P = Om Rabiaa under ZT

L X C X P = Sham/3 under Chisel in Rabiaa location

Table (51) Effect of planting methods on No. of spikes /m^2 of durum wheat in SI locations .

Location (L)	Planting Method (P) / Cultivars (C)	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Sham/3	303. 00 e	214. 66 i	250. 66 h	256.10 c

	OM Rabiaa	142. 66 n	175. 33 m	191. 00 k	169. 66 e
Rabiaa	Sham/3	277. 33 f	432. 00 a	246. 33 h	318. 55 b
	OM Rabiaa	340.00 d	414.33 b	375.33 c	376.55 a
Hamidat	Sham/3	125.00 O	170.66 m	208.00 j	167.88 e
	OM Rabiaa	183.66 L	185.66 kL	268.66 g	212.66 d
					(L)
L x P Interaction	ALNamroud	222.83 d	194.00 e	220.83 d	212.88 b
	Rabiaa	308.67 b	423.17 a	310.83 b	347.56 a
	Hamidat	154.33 g	178.16 f	238.33 c	190.27 c
					(C)
C x P Interaction	Sham/3	235.11 d	272.44 b	235.00 d	247.52 b
	OM Rabiaa	222.11 e	258.44 c	278.33 a	252.96 a
(P)		228.61 c	265.44 a	256.66 b	

H-3- Weight of 1000 Grains (gm):

As shown in table 5) the best results of this trait in factors and interactions are summarized below:

P = ZT

C = Sham/3 and Om Rabiaa (NS)

L = Hamidat and Rabiaa locations

L X C = Om Rabiaa in Hamidat and Rabiaa locations and Sham/3 in Hamidat location

L X P = Z.T IN Hamidat

C X P = Om Rabiaa under ZT

L X C X P = Om Rabiaa and Sham/3 under Z.T. in Hamidat location

Table 52 Effect of planting methods on weight of 1000 grains (gm) of durum wheat in SI locations .

Location (L)	Planting Method (P) / Cultivars (P)	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Sham/3	24.00 ef	22.80 ef	25.04 e	23.94 b
	OM Rabiaa	25.46 e	25.53 e	21.60 f	24.19 b
Rabiaa	Sham/3	31.50 bcd	30.00 cd	31.90 bcd	31.13 a
	OM Rabiaa	32.07 bcd	30.91 bcd	33.35 bc	32.11 a
Hamidat	Sham/3	30.07 cd	32.80 bc	34.13 ab	32.33 a
	OM Rabiaa	28.80 d	32.33 bcd	37.13 a	32.75 a
					(L)
L x P Interaction	ALNamroud	24.73 d	24.17 d	23.32 d	24.07 b
	Rabiaa	31.79 b	30.46 bc	32.63 b	31.63 a
	Hamidat	29.44 c	32.57 b	35.63 a	32.55 a
					(C)
C x P Interaction	Sham/3	28.52 b	28.53 b	30.36 ab	29.14 a
	OM Rabiaa	28.78 ab	29.59 ab	30.69 a	29.69 a
(P)		28.65 b	29.06 b	30.52 a	

H-4-N0. of Grains / Spikes:

As shown in Table 53 the best results of this trait in factors and interactions are summarized below:

P = ZT

C = Sham/3

L = Hamidat location

L X C = Sham/3 in Hamidat location

L X P =Z.T. and Chisel in Hamidat location
C X P = Sham/3 under Z.T and Chisel
L X C X P = Sham/3 under chisel and Z.T and Om Rabiaa under Z.T in Hamidat location

Table 53 Effect of planting methods on No. of grains/spike of durum wheat in SI locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Sham/3	33.50 e	34.20 bc	37.00 a	34.90 a
	OM Rabiaa	21.97 g	19.50 h	22.47 g	21.31 d
Rabiaa	Sham/3	29.30 ef	29.17 ef	28.60 f	29.02 c
	OM Rabiaa	28.07 f	29.17 ef	29.46 ef	28.90 c
Hamidat	Sham/3	31.86 d	36.83 a	35.40 ab	34.69 a
	OM Rabiaa	30.40 de	34.43 bc	36.13 a	33.65 b
					(L)
L x P Interaction	ALNamroud	27.74 d	26.85 d	29.74 c	28.10 c
	Rabiaa	28.69 c	29.17 c	29.03 c	29.00 b
	Hamidat	31.13 b	35.63 a	35.77 a	34.17 a
					(C)
C x P Interaction	Sham/3	31.55 b	33.40 a	33.67 a	32.87 a
	OM Rabiaa	26.81 d	27.70 d	29.35 c	27.95 b
(P)		29.18 c	30.55 b	31.51 a	

H-5- Straw Biomass (gm/m2):

As shown in Table 54 the best results of this trait if factors and interactions are summarized below:
P = Chisel
C = Sham/3
L = Rabiaa location
L X C = Sham/3 in Rabiaa location
L X P = Chisel in Rabiaa location
C X P = Sham/3 under Chisel
L X C X P = Sham/3 under Chisel in Rabiaa location

Table 54 Effect of planting methods on straw biomass (gm/m^2) of durum wheat in SI locations

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Sham/3	134.24 k	135.81 k	102.65 m	124.23 e
	OM Rabiaa	53.60 p	69.93 O	85.94 n	69.82 f
Rabiaa	Sham/3	432.67 d	665.33 a	403.38 f	500.46 a
	OM Rabiaa	423.13 e	554.00 b	471.46 c	482.86 b
Hamidat	Sham/3	107.96 m	157.31 j	266.36 h	177.21 d
	OM Rabiaa	128.10 L	234.80 i	316.08 g	226.32 c
					(L)
L x P Interaction	ALNamroud	93.92 h	102.87 g	94.30 h	97.03 c
	Rabiaa	427.9 c	609.67 a	437.42 b	491.66 a
	Hamidat	118.03 f	196.06 e	291.22 d	201.77 b
					(C)
C x P Interaction	Sham/3	224.96 e	319.48 a	257.46 d	267.3 a
	OM Rabiaa	201.61 f	286.24 c	291.16 b	259.67 b

(P)	213.28 c	302.86 a	274.31 b	

H-6- Plant Height (cm) :

As shown in Table 55 the best results of this trait in factors and interactions are summarized below:

P = ZT

C = Om Rabiaa

L = Rabiaa location

L X C = Om Rabiaa then Sham/3 in Rabiaa location

L X P = Z.T. in Rabiaa location

C X P = Om Rabiaa under ZT

L X C X P = Om Rabiaa under Z.T in Rabiaa location

Table (55) Effect of planting methods on plant height (cm) of durum wheat in SI locations .

Location (L)	Planting Method (P) / (C) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Sham/3	68.53 f	58.76 g	57.53 g	61.60 e
	OM Rabiaa	52.13 h	49.76 h	45.17 i	49.02 f
Rabiaa	Sham/3	87.46 b	82.26 cd	83.93 bcd	84.55 b
	OM Rabiaa	83.30 bcd	84.63 bcd	109.00 a	92.31 a
Hamidat	Sham/3	58.16 g	65.66 f	74.63 e	66.15 d
	OM Rabiaa	61.56 g	86.30 bc	81.66 d	76.50 c
					(L)
L x P Interaction	ALNamroud	60.33 d	54.26 e	51.35 f	55.31 c
	Rabiaa	85.38 b	83.45 b	96.47 a	88.43 a
	Hamidat	59.86 d	75.98 c	78.15 c	71.33 b
					(C)

C x P Interaction	Sham/3	71.38 b	68.89 c	72.03 b	70.76 b
	OM Rabiaa	65.66 d	73.56 b	78.61 a	72.61 a
(P)		68.52 c	71.22 b	75.32 a	

H-7- Gains Specific weight (kg/ hectoliter):

As shown in Table 56 the best results of this trait in factors and interactions are summarized below:

P = Control planting method.
C = Sham/3 and Om Rabiaa (NS)
L = Hamidat
L X C = Om Rabiaa in Hamidat location
L X P = Con. in Hamidat location
C X P = Sham/3 under Con. Planting method
L X C X P = Om Rabiaa under Z.T. and Con. in Hamidat location

Table (56) Effect of planting methods on grains specific weight (kg/hectoliter) of durum wheat in SI locations .

Location (L)	Planting Method (C) (P) Cultivars	Con.	Chisel	Z.T.	L x C interaction
ALNamroud	Sham/3	70.3 cd	71.3 b	71.0 bc	70.8 b
	OM Rabiaa	65.7 g	64.7 h	62.7 i	64.3 e
Rabiaa	Sham/3	66.7 f	67.0 f	66.7 f	66.8 d
	OM Rabiaa	70.0 d	70.3 cd	70.0 d	70.1 c
Hamidat	Sham/3	74.3 a	67.0 f	68.7 e	70.0 c
	OM Rabiaa	74.0 a	71.0 bc	74.0 a	73.0 a
					(L)
	ALNamroud	68.00 e	68.00 e	66.85 f	67.61 c

L x P Interaction	Rabiaa	68.35 de	68.65 cd	68.35 de	68.45 b
	Hamidat	74.15 a	69.00 c	71.35 b	71.50 a
					(C)
C x P Interaction	Sham/3	70.43 a	68.43 c	68.80 c	69.22 a
	OM Rabiaa	69.90 b	68.67 c	68.90 c	69.15 a
(P)		70.16 A	68.55 b	68.85 b	

3.1.2.1.3 Discussion

The discussion identifies and discusses possible causes of superiority in grain yield related to location, planting methods or cultivar, based on the mean values of these three factors in the results tables.

1. LRA locations

1- A- Locations factor:
The Tell Abta location was superior in the amount of grain yield. The Al Hatra location was omitted from the evaluation because of the dryness and lack of a harvest for this season. The rainfall in Al Mahalabia was 273mm and in Tell Abta was 187m, and it is suggested that the Tell Abta location was superior in grain yield because of the following causes:
- a large amount of rain fell in Al Mahalabia in October, one month before the sowing date, and some of this rain was lost to the crop
- the clay loam soil at Tell Abta location was more able to save water than the sandy loam soil in Al Mahalabia

1- B- Planting method factor:
The zero till planting method generally gave better grain yields than the farmer method (control) and chisel cultivation in Tell Abta.

It was noticeable in Tell Abta that when the number of ploughings was increased and tillage was deeper, this led to lower grain yields because the limiting factor in this location was rainfall. It is thought that the better infiltration and storage of rain water in the soil was in the ZT treatment than the farmer and chisel methods, where soil disturbance was higher.

1- C- cultivars factor
There were no significant differences in the grain yield between the two varieties (Zanbaka and Local Black) of barley in spite of the superiority of Zanbaka in the traits of plant height and straw biomass.

2. MRA locations

2- A- Locations factor:
The Telkief location was superior in grain yield of durum wheat, bread wheat and barley varieties. The was thought to be due to the soil texture of the Telkief location which is clay loam, in comparison with Bashiqa and Al Hamdania which are loam, which meant that the Telkief soil could store rain water better than the other locations. In addition, the rainfall in the growing season (337mm) was adequate, timely and balanced in Telkief whilst Bashiqa recorded a lower 193 mm. In Hamdania, rain fall was higher (386 mm), but it is considered crops suffered from two environment factors: firstly, there was high rainfall in February (more than 140 mm) when the growth was stopped because of the extreme cold which effect Nineveh during this period and, secondly, the location was exposed to hot eastern wind during the spike flowering which led to lower pollination.

2- B- Planting method factor:
Chisel was superior in MRA followed by ZT and control. It seemed that the deep chisel tillage made a soft and good root region and this led to good root growth especially with good rains which helped in the superiority of this method planting.

2- C- Cultivars factor:
In general, for the three locations, the bread wheat cultivar Sham/6 was better than Abu Ghraib, which was related to the number of spikes/m^2 and low plant height for this cultivar which obtained a nutritional balance for grains yield. For durum wheat, there were no significant differences between the two varieties of wheat, Karonia and Om Rabiaa. For barley, the variety Rihan/3 was better than the Jazzera variety, due to the superior of Rihan for the traits of weight of 1000 grains and the number of grains/spike.

3. HRA locations

3- A- Locations factor
The Al Qush location was superior in grain yield for durum and bread wheat. This was in spite of the higher growing season rainfall in Al Shykhan (471 mm) than Al Qush (369.5), because the rain for the two months of April and March which is very necessary to grain growth was low in Al Shykhan compared with Al Qush

3-B- Planting methods factor
The chisel planting method was superior to ZT for both the bread and durum wheat crops. We supposed that the ZT planting method is more beneficial in the locations which suffer from rainfall shortages because of it's efficiency to reduce the evaporation from the soil surface and increase rain water storage. In HRA locations, farmers tend to chisel to depth in the soil to encourage formation of good plant roots.

3-C- Cultivars factor
There was no significant difference in the grain yield between the two bread wheat varieties Abo Gharaib and Sham/6. For durum wheat, the variety Karonia was better then Sham/3, seemingly due to the ability of Karonia to produce high numbers of spikes per plant and high 1000 grain weights.

4. SI locations:

4- A- Locations factor:
The Rabiaa location was superior to Hamidat and Al Namroud, probably because the March and April rains in Rabiaa were better than at Al-Namroud and Hamidat and perhaps associated with hot easterly winds during the flowering period in Hamidat and Al-Namroud.

In spite of the low total rainfall in Rabiaa and the fact that the irrigation project did not work for this season in Rabiaa and Al-Namroud, moisture was available in the Rabiaa location as the

demonstration was done in the area planted in the last season with a summer irrigated crop, and this led to an increase of stored water in the soil of the Rabiaa location .

4- B- planting methods factor:
The ZT planting method was better compared with chisel followed by control establishment. This was due to the role of ZT in keeping soil moister through good rain water harvesting and reduced evaporation.

4- C- Cultivars factor:
The variety Tell Affer was better than Adnanaia and it seems that the variety Adnanaia was less tolerant to drought and less successful than in the last year under irrigation conditions. The high grain yield of the variety Tell Affer/3 seemed related to higher spikes/m^2 and grains/spike.

In durum wheat, the variety Sham/3 was better than Om Rabiaa perhaps due to high grains/spike and equal with Om Rabiaa in the weight of 1000 grains and specific weight of grains.

General notes

1. In the 2006-07 season, there was good rainfall during October, November and December and this facilitated early sowing for most farmers at the end of December and the beginning of January. However, yields were reduced by two weather factors. There was an extremely cold period in Ninevah during February which coincided with the start of seed germination in the field and this led to high seedling loss. In addition, there was a hot easterly wind in the flowering stage in most of the locations which led to reduced seed production/grain yield.

2. Table 57 provides a comparison of the three planting methods in barley, bread wheat and durum wheat by listing the method which gave the highest value for each of the listed traits. The chisel planting method gave the highest values in a total of 36 site/trait combinations followed by ZT in 28 and farmer methods in 8. This result provides strong encouragement to continue the project with the farmers. It is our belief that we need to pay more care to the ZT planting method for the next season by training the working drivers on the seeder machines before the planting season and we expect that this will raise the farmer evaluation of the ZT planting method, especially for its lower economic cost and its faster speed in application.

Table 57 The highest significant value of crop traits according to planting methods and its overall representation in each planting method

Locations and Crops / Traits	SI Durum Wheat	HRA Durum Wheat	MRA Durum Wheat	SI Bread Wheat	HRA Bread Wheat	MRA Bread Wheat	MRA Barley	LRA Barley
Grains yield (gm/m^2)	ZT	Chisel	Chisel	ZT	Chisel	Chisel	Chisel	ZT
No. spikes/m^2	Chisel	Chisel	Chisel	ZT	Chisel	Chisel	Chisel	ZT
1000 grain weight (g)	ZT	Chisel	Con	All	ZT	ZT	Chisel	All
No. grains/spike	ZT	Chisel	ZT and Chisel	ZT and Chisel	ZT and Chisel	ZT	All	Chisel
Straw biomass (gm/m^2)	Chisel	Chisel	Chisel	ZT	Chisel	Chisel	Chisel	All
Plant height (cm)	ZT	Chisel	Chisel	ZT	Chisel	ZT	ZT	ZT

Specific weight (kg/hectoliter)	Con	Chisel	All	ZT	Chisel	All	ZT	ZT and Chisel

Traits	Chisel	ZT	Con
Grains yield (gm/m^2)	5	3	-
No. spikes /m^2	6	2	-
1000 grain weight (g)	4	5	3
No. grains/ spike	6	6	1
Straw biomass (g/m^2)	7	2	1
Plant height (cm)	3	5	-
Specific weight (kg/hectoliter)	5	5	3
Total	36	28	8

3.1.2.2 Comparison of crop performance of a range of varieties/lines of barley and wheat at Bartella (MRA)

3.1.2.2.1 Materials, methods and results

A range of cultivars/lines of wheat and barley were evaluated and compared at the extension farm at Bartella, 2 km from Hammdania and under the same environmental conditions (rainfall, temperature, soil, etc.). Sowing rate for all crops was 1.2 kg/100m^2.

Yields were generally below 1t/ha with large differences between varieties/lines; results are presented in Tables 58 and 59.

For barley, the highest values for various traits are presented in Table 58 and summarized below:

- plant height (cm) - Zanbaka group
- spikes/m^2 - Zanbaka group
- straw biomass (gm/m^2) - Zanbaka group
- grains /spike - Zanbaka then Zanbaka SLB74 then Rihan/3
- weight of 1000 grains (gm) - Alanda hamra then Zanbaka group
- grain yield (gm/m^2) - Zanbaka then Zanbaka SLB74 then Rihan/3
- grain yield (kg/100m^2) - Zanbaka (900kg/ha), ZanbakaSLB74 (870kg/ha), Rihan/3 (820kg/ha)

For bread wheat, the highest values for various traits are presented in Table 59 and summarized below:

- plant height (cm) - Abouzic/9 then Anji/2 and babaga/3
- spikes/m^2 - Abouzic /9 then Babaga/3 and Dajaj/5
- straw biomass (gm/m^2) - Abouzic /9 then Anji/2 and Babaga/3
- grains/spike - Abouzic/9 then Babaga/3 and Anji/2
- weight of 1000 grains (gm) - N.S.
- grains yield (gm/m^2) - Abouzic/9 then Babaga/3 then Dajaj/5
- grains yield (kg/100 m^2) - Abouzic/9 (700kg/ha), Babaga/3 (380kg/ha), Anji/2 (230kg/ha)

For durum wheat, the highest values for various traits are presented in Table 59 and summarized below:

- plant height (cm) - Beltagy /2 then sham/5 then Fadda/98
- spikes/m^2 - Beltagy /2 then Younes/1 then Ammar /1
- straw biomass (gm/m^2) - Beltagy /2 then Fadd/98 then Younes /1
- grains/spikes - Ammar/3 then Beltagy /2 then Azeghhar

- weight of 1000 grains (gm) - Ammar /1 then ICASYR/2
- grain yield (gm/m^2) - Beltagy /2 then Younes /1 then Ammar/3
- grain yield (kg/100m^2) - Beltagy/2 (450kg/ha), Younes/1 (370kg/ha), Ammar/3 (325kg/ha)

Table 58 Evaluation of barley cultivars at Bartella (MRA)

Crops	Cultivars	Traits						
		Plant height (cm)	Spikes/ m^2	Straw biomass (g/m^2)	Grains/ spike	Weight 1000 grains (g)	Grain yield (g/m^2)	Grain yield (kg/100m^2)
Barley	Alanda/1	50.16	39.33	16.18	15.53	25.6	26.08	6.00
	Alanda hamra	54.83	46.66	17.98	28.96	33.2	26.98	6.50
	Alanda zafraa	53.23	40.00	17.43	16.13	22.8	25.15	5.50
	Zanbaka	62.83	62.33	26.66	37.80	27.4	35.56	9.00
	Zanbaka SLB 81	60.50	60.00	22.98	29.50	32.2	27.86	7.10
	Zanbaka SLB 74	60.23	60.95	25.08	34.06	27.6	31.70	8.70
	Rihan/3	53.96	55.33	19.25	33.50	26.8	31.33	8.20
	Rihan 03/ Lignee	55.30	49.66	18.08	29.33	23.6	26.51	6.30
	Yazan	49.36	43.33	15.76	17.50	24.8	25.66	5.50
	Momtaz	60.26	41.00	16.96	15.80	25.2	24.08	5.30

Table 59 Evaluation of wheat cultivars at Bartella (MRA)

Crops	Cultivars	Traits						
		Plant height(cm)	Spikes/m^2	Straw biomass (g/m^2)	Grains/ spike	Weight 1000 grains (g)	Grain yield (g/m^2)	Grain yield (kg/100m^2)
Bread wheat	Abouzic/9	64.00	33.00	20.65	28.03	22.2	25.40	7.00
	Hamma	39.56	14.33	7.00	16.16	22.4	9.56	1.40
	Anji/2	49.96	15.66	14.40	23.33	22.6	15.05	2.30
	Dajaj/5	43.63	19.00	10.71	20.96	22.0	14.48	2.10
	Babaga/3	49.90	21.66	13.11	23.66	22.6	17.15	3.80
	Qimma/6	39.40	13.00	9.31	15.53	22.0	10.23	2.00
Durum Wheat	Sham/5	62.40	20.33	11.78	24.43	22.2	15.00	3.00
	ICASYR/2	52.10	16.00	8.25	20.40	24.6	12.52	2.10
	Beltagy/1	56.46	19.00	11.00	17.90	24.0	12.48	2.25

	Beltagy/2	65.36	35.00	17.60	24.76	22.2	20.01	4.50
	Younes/1	59.20	26.00	12.58	21.56	21.4	18.53	3.70
	Ammar/3	56.86	17.00	9.21	25.46	22.0	15.70	3.25
	Ammar/1	50.96	25.33	10.08	20.56	25.0	13.90	3.00
	Ammar/6	59.36	24.00	10.68	21.06	23.8	13.50	2.60
	Lahnhducam	-	-	-	-	-	-	-
	Fadda/98	59.93	22.00	14.15	22.10	22.8	14.95	2.70
	Azeghar/2	50.96	15.00	8.41	24.10	24.0	12.83	2.50

3.2. Forage legumes

Dr Kassim Khalil Kasim, MOA, Mosul, Ninevah, Iraq

3.2.1 Objectives

1. To increase the productivity of wheat and barley.
2. To introduce forage legumes such as vetch for increasing forage production

3.2.2 Introduction

The cropping system in the low/limited rainfall area (200-350mm) is based on a cereal (barley) and fallow rotation. It is a problem with fallowing that half of the land is left idle and exposed to soil erosion by rain and wind. There are also economic losses from leaving half of the land without cultivation/crops. The area of this region is about 1 million hectare. Growing of forage legumes may provide an alternative to fallowing and also support increased cereal productivity mainly and availability of forage resources for sheep grazing.

In the moderate rainfall area (350-450mm), a different crop rotation is practiced with cereal (wheat) and food legumes (lentil and chickpeas). The area of this region is about 0.5million hectares. In recent years some attention has been given to developing this area through introducing forage legumes such as common vetch (Vicia sativa L.) or lathyrus (Lathyrus sativus) aiming for seed production which is the main source of protein (24%) contributing about 10% in sheep diets or for hay making (mixture 75% vetch:25% barley).

3.2.3 Forage demonstrations

3.2.3.1 Materials and methods

Forage legumes activities were carried out in the low rainfall area (200-350mm) at Hatra , Tel-Abta and Mahalabia. These demonstrated a mixture of two-rowed black local barley with common vetch (Vicia sativa L.cv.lPA2001) at a ratio of 3:1(75 %common vetch with 25%barley) sown at 100kg/ha for common vetch and 20kg/ha for barley. An area of 1 hectare was allocated for each activity for each location. The land was ploughed and cultivated by local machines (drill disk). Date of sowing was 20, 20, and 25 December 2006 for Mahalabia, Hatra, and Tel-Abta respectively.

In moderate rainfall areas (350-450mm), different activities were conducted at Telkief, Hamdanyia, and Bashiqa. These demonstrated cultivation of 1 hectare each of common vetch (Vicia sativa L. cv.lPA 2001) and woollpod vetch (Vicia dasycarpa.cv. kouhak 96) at Telkief , Hamdanyia, and Bashiqa and 0.5 ha of Lathyrus sativus cv.Ali –Bar at Telkief and Hamdanyia. Seeding rate of common vetch and woollypod was 100kg/ha .

In addition, a mixture of 75% common vetch cv. IPA 2001 with 25% two rowed black barley was demonstrated at Hamdanyia . The land was ploughed by chisel and was seeded by local machines. Seeding rate was 120kg/ha for Lathyrus. Date of sowing was 18, 20, and 19 January 2006 for Telkief , Hamdanyia and Bashiqa respectively. Dry matter yield was estimated at flowering time by quadrats (1x1m) repeated 10 times for each demonstration at each location then dried in the oven at 75 C° for 48 hrs.

Table1 The amount of rainfall (mm) and its monthly distribution for the growing season 2006/07 at different locations

Months	Limited rainfall area			Moderate rainfall area			
	Mahalabia	TelAbta	Hatra	Telkief	Hamdanyia	Bashiqa	Mosul
October	102	38	33	43	63	19	27
November	3	27	-	40	23	15	10
December	30	17	11	53	30	34	45
January	29	22	23.5	32.5	37	26	23

February	66	61	35	68.5	142	44	81
March	14	13	4.5	34	40	23	31
April	29	9	7	35.5	40	37	34
May	-	-	-	-	46	-	7
	273	187	114	306.5	381	198	258

Source: Ninivah Agriculture Directorate

3.2.3.2 Results and discussion

In the low rainfall areas (Table 2), there were some differences in production between the three locations, with dry matter yield increased at Mahalabia by 74% and 98% over Hatra and Tel-Abta respectively. These differences were related mainly to the amount of rainfall (Table1).

Table2 Mean of dry matter yield of mixture (kg/ha) , height of plant (cm.) of common vetch and its utilization at three locations for the growing season 2006/2007

Characters	**Locations**		
	Tell-Abta (187mm)	Hatra (114mm.)	Mahalabia (267mm)
Dry matter yield	201	176	350
Height of plant	8	8	12
Utilization	Sheep grazing	Sheep grazing	Sheep grazing

Cultivation of common vetch under limited rainfall is risky because of the fluctuation of the amount of rainfall between years .There is a common sense amongst the farmers or growers working under this area that cultivation is like playing cards, as the farmer is used to getting a yield only once per four years even for cereal crops such as barley.

In accordance with previous results, the conclusion should be made here that there is no benefit to continue with the cultivation of common vetch under limited rainfall (200-350mm) because it is not economically viable.

In the moderate rainfall areas (Tables 3, 4), there was a trend to some differences in dry matter yields, biological yields and seed yields between Vicia sativa and V. dasycarpa within and between the two locations of Telkief and Bashiqa, with values tending to be higher at Telkief than Bashiqa. There was good growth of Lathyuas sativus cv. Ali –Bar in Telkief. Results are presented in Table 3.

Table 3 Mean of dry matter, biological and seed yields(kg/ha) and height of plant (cm) of vetches and lathyrus at Telkief for the growing season 2006/07

Species	**Dry matter yield**	**Biological yield**	**Seed yield**	**Height of plant**
Vicia sativa	891	2905	780	30
V. dasycarpa	658	2611	591	34
Lathyrus sativus	838	3372	856	32

Tables 3 and 4 also showed plant heights at the Telkief and Bashiqa locations. These did not differ much between species but sites differed due mainly to the differences in the amount and monthly distribution of rainfall (Table 1).

Results from Hamdanyia were omitted because growth and yield of crops were affected by vigorous weeds, especially broad leaves, which were difficult to control.

3.2.4 Forage Research

Comparison between 16 lines of common vetch (Vicia sativa L.) at AL-Rashidyia research station for the growing season 2006/07

Lines	DFLR days	DMAT days	PTHT(cm.)	YLD(2.1m2)	BYLD(2.1m2)	Wt100 seeds (g)
1	124	159	49	329	671	5.95
2	130	162	16	67	221	2.95
3	133	168	58	297	814	4.10
4	122	160	42	284	643	5.75
5	135	170	49	176	345	5.20
6	133	167	40	216	695	4.30
7	127	160	46	344	801	5.10
8	134	170	41	184	307	4.40
9	124	160	39	226	493	5.15
10	134	169	46	232	380	4.85
11	133	169	41	207	446	5.10
12	132	161	46	193	398	6.05
13	135	169	41	196	404	5.25
14	131	167	39	208	463	5.71
15	126	163	42	212	316	6.75
16	121	153	30	284	471	5.60

Selected lines	DFLR(days)	DMAT(days)	PTHT(cm)	YLD (2.1m2,gms)	BYLD (2.1m2,gms)	Wt100 seed (gms)
1	124	159	49	329	671	5.95
4	122	160	42	284	643	5.75
7	127	160	46	344	801	5.10
9	124	160	39	226	493	5.15
12	132	161	46	193	398	6.05
14	131	167	39	208	463	5.71
15	126	163	42	212	316	6.75
16	121	153	30	284	471	5.60

DFLR: days from sowing to 50% flowering
DMAT: days from sowing to maturity
PTHT: height of plant (cm)
YLD: seed yield (2.1m2,gms)
BYLD: biological yield (2.1m2, gms)

3.3 IPM research at demonstration sites (AlHamdania and Tel Kief)

3.3.1 Studies on the wheat leaf miner (Syringopais temperatella Led.) in wheat and barley

Professor Dr. Suaad Irdeny Abdullah
Plant Protection Department, College of Agricultural and Forestry, Mosul University, Iraq

Introduction
The leaf minor Syringopais temperatella Led. has great significance for wheat and barley in the north of Iraq. Some of the earliest studies of the biology and ecology of this pest were conducted in Iran and Turkey. There is one generation per year which attacks the leaves of the plants, especially where larvae mine through leaves of wheat and barley. Adults usually appear in the field during the second half of April. Each female lays about 29 eggs. After hatching, the larvae form cysts in which they aestivated as first instars during summer, autumn and part of winter. They resume activity at the second half of January. The larvae moult three times (4 instars), with the larval period lasting for about 315 days. By the first half of April, the fully-fed larvae enter the soil and construct cocoons in crevices at a depth of about 0.3 – 4 cm. The pupal period averages 14 days.

This study was undertaken in controlled fields infested every year by wheat leaf miner Syringopais temperatella Led. in Al-Hamdania and Tellkief regions and reports on susceptibility of wheat and barley crops to infestation by this pest and control by insecticides and planting methods. All the varieties of these crops tested were planted in fields with cereal and legume rotations.

The results showed that the larvae came out of dormancy and emerged from soil in fields planted with cereals and attacked the weeds or infested the cereals in the neglected bare areas or those which were planted by legumes, often before the growth of cereals in the neighboring areas on 17/1/2007. Some Rihan barley variety plants were found in the areas assigned for legume cultivation and many were heavily infested by leaf miner. The larvae had started to make tunnels between the epidermal layers of the leaves. The picture below shows the damage of leaf miners on leaves. After this, the larvae transferred to attack the wheat variety Abu Ghraib after 33 days from the emergence stage.

The following studies were undertaken in the demonstration plots of barley and wheat in AlHamdania and el Kief villages. In all studies, tthe insecticide Disez (ULV) was used at a rate of 250 ml/dounm on18/5/2007 to control Sunn pest in all of the experimental plots of wheat.

3.3.1a Control of leaf miner in wheat under chisel and zero-till establishment in AlHamdania

An IPM experiment was undertaken in the project demonstrations in Twajna village (ALHamdania) investigating control of leaf miner. Granular Diazinon (10% a.i.) at a rate of 2.5 kg/dounm was

mixed with seed of the Abu Ghraib wheat variety in the zero tillage and chisel treatments, after using Gramoxone for weed control at 1 liter/dounm.

Materials and Methods
Planting was on 17/1/2007, with the first rain on 29/1/2007. Seed emergence was on 19/2/2007. On 14/3/2007, 30 plants were pulled out at random from the two treatments to determine the percentage of the infested leaves, number of tunnels made by larvae and the number of live larvae for each plant.

Results and Discussion

Table 1 The effect of ploughing methods on the percentage of infested leaves, number of tunnels and live larvae/plant in wheat variety Abu Gharaib

Ploughing Methods	Date of sampling	% infested leaves/ plant	Number of tunnels/plant	Number of alive larvae/ plant
Zero tillage	14/3	15.2	1.1	0.3
Chisel	14/3	20.3	1.5	0.9

A: The treatment with Diazinon showed a decrease in percentage of the infested leaves, number of tunnels and live larvae/plant under zero tillage compared with the chisel.
B: The effect of the insecticide was clearly noticed on live larvae inside the tunnels in zero tillage compared with the chisel.

Discussion:
Perhaps this difference between zero-till and chisel ploughing was due to the sowing operations which exposed the insecticide to adsorption in the soil or absorption by the plant. The adsorption will happen to a larger degree in dry soils compared with moist soils. The soil moisture degree leads to a change of balance between absorption and adsorption. There is a trend towards adsorption by the soil in the chisel treatment and towards absorption by the plant in the zero tillage treatment. In addition, leaching by rain happens rapidly and insecticide penetrates into the depths of the soil in the chisel treatment.

3.3.1b Varietal susceptibility to leaf miner of wheat under different planting methods in AlHamdania

Materials and methods
Randomized samples (30 plants) were taken from each treatment (zero tillage, chisel and control) from each variety (Om Rabee, Sham/6 and Karuniya). A test was undertaken to determine the susceptibility of different varieties to infestation with wheat leaf miner and the impact of the ploughing methods on the infestation by this insects.

Table2 The effect of varieties and ploughing methods on the percentage of infested leaves , number of tunnels and number of larvae for each plant.

Varieties	Ploughing methods	% infested leaves/ plant	No. of tunnels/plant	No. of live larvae/ plant
Om Rabee	**Control**	38.5	4.8	1.4
	Chisel	40.0	4.4	1.9
	Zero tillage	38.5	2.3	1.7
Sham /6	**Control**	36.5	6.0	1.5
	Chisel	35.9	6.5	3.2
	Zero tillage	23.9	2.0	0.9
Karuniya	**Control**	75.4	3.5	1.2
	Chisel	46.9	4.4	1.6
	Zero tillage	35.7	3.3	1.7

Results

A: All varieties (Om Rabee, Sham/6, Karunyia) were characterized in the zero tillage treatment by a decrease in the infested leaves percentage and the number of tunnels for each plant compared with the treatments of control and chisel for the same varieties.

B: The Sham/6 variety of wheat was characterized with a decrease in the percentage of infested leaves and tunnels and live larvae under zero tillage compared with varieties Um Rabee and Karunyia.

C: There was a decrease in the number of live larvae in the wheat variety Sham/6 in the zero tillage treatment. The relative number of live larvae was 1.6 times more in the control treatment and 3.3 times more in the chisel treatment compared with the zero tillage treatment.

D: The relative number of live larvae was 1.9 times more in the varieties Om Rabee and Karunyia under zero tillage compared with the wheat variety Sham/6 under the same treatment .

Discussion

The preferences of the wheat leaf miner larvae for a certain variety over another may be due to differences in natural materials which affect the larvae test or in morphological characteristics of plants which affect larvae behavior, and make it more attractive and acceptable. It is known that thickness of the epidermis often increases plant resistance to insects.

3.3.1c Variety and Diazinon effects on wheat leaf miner in zero-till wheat in Telkief

Materials and methods

Gramaxon was used for control the weeds on 20/1/2007 at a rate of 1 liter/dounm. On 21/1/2007, granular Diazinon (10% a.i.) at a rate of 2.5 kg/dounm was mixed with the seed from two varieties of wheat (Tell Affer/3 and Karunyia) in the zero tillage treatment.

Randomized samples (30 plants from each variety) were taken at two times (22/2/2007 and 12/3/2007) to check the percentage of infested leaves, number of tunnels and number of live larvae for each variety.

Table 3 The effect of varieties and date of sampling on percentage of infested leaves, number of tunnels and live larvae for each plant.

Varieties	Date of sampling	% infested leaves/ plant	No. of tunnels/ plants	No. of live larvae/ plants

Tell Affer/3	22/ 2	38.4	3.1	1.0
	12/ 3	33.0	3.4	1.1
Karunyia	22/ 2	30.9	2.5	0.8
	12/ 3	25.4	2.0	0.2

Results

A: The Karunyia wheat variety showed a lower percentage of infested leaves, tunnels and live larvae compared with wheat variety Tell After /3 at both the first (22/2/2007) and second (12/3/07) sampling.

B: Wheat leaf miner larvae showed more preference for infesting wheat variety Tell Affer/3 and less preference for wheat variety Karunyia.

C: Granular Diazinon led to a decrease in live larvae, especially on the wheat variety Karunyia. The relative number of live larvae was four times more on the same variety on the first date in 22/2 compared with the second date 12/3.

3.1.3d Variety and cypermethrin effects on Wheat Leaf miner in different varieties of wheat with three planting methods in Telkief

Materials and methods

Chevalier was added to control weeds on 13/3/2007 at a rate of 72 g/dounm in a mixture with alpha cypermethrin 50% to control leaf miner at a rate of 100 ml/ dounm for the two varieties of wheat (Tell Affer/3 & Karunyia), which were sown with three methods (chisel, zero tillage & control). Randomized samples (30 plants) were taken from each experimental unit at two times after spraying, 16/3/2007 and 25/3/2007. The samples were checked to determine the percentage of infested leaves, number of tunnels and number of live larvae for each plant.

Results

Table 4 The effect of varieties, ploughing methods and date of sampling on the percentage of infested leaves, number of tunnels and live larvae for each plant.

Varieties	Ploughing methods	Date of sampling	% infested leaves/plant	No. of tunnels/plant	No. of live larvae/plant
TellAffer3	**Control**	16/3	34.7	4.7	1.3
		25/3	9.3	0.4	0.2
	Chisel	16/3	41.5	4.2	1.8
		25/3	23.0	1.4	0.3
	Zero till	16/3	33.0	3.4	1.1
		25/3	13.0	0.2	0.1
Karunyia	**Control**	16/3	38.1	4.1	1.1
		25/3	21.1	1.3	0.1
	Chisel	16/3	38.4	4.2	1.8
		25/3	35.1	2.5	0.8
	Zero till	16/3	25.4	2.0	0.2
		25/3	5.8	0.4	0

There was a decrease in the percentage of infested leaves, number of tunnels and number of live larvae due to the use of alpha cypermethrin after twelve days compared with after three days for the variety Tell affer/3, as follows:
a: control treatment: The numbers of infested leaves, tunnels and live larvae were respectively 3.7,11.8 and 6.5 times higher at three days after spraying than after twelve days.
b: Chisel treatment: The numbers infested leaves, tunnels and live larvae were respectively 1.8 , 3 and 6 times more at three days after spraying than after twelve days.

In the case of Karunyia under zero tillage after treatment with alpha cypermethrin, there was a decrease in infested leaves and tunnel numbers after twelve days compared with after three days as follows:
a: The relative number of infested leaves and tunnels was about 4.4 and 5 times greater respectively three days after spraying compared with after twelve days.
b: Live larvae were absent in Karunyia variety at twelve days after treatment with alpha cypermethrin.

3.3.1e. Variety and cypermethrin effects on wheat leaf miner in two varieties of barley planted under three methods in Telkief

Materials and methods
In barley demonstration plots, Granstar and Locsan were used at a rate of 5 g/dounm and 650 ml/dounm for weed control and alpha cypermethrin at a rate of 100 ml/dounm to protect from wheat leaf miner, with spraying on 13/3/2007 .

Randomized samples (30 plants) were taken for both varieties of barley (Jazzera and Rihan) under each planting method (control, chisel and zero tillage) on 16/3/2007 and 25/3/2007. The samples were checked to determine the percentage of infested leaves, number of tunnels and live larvae for each plant.

Table 5 The effect of varieties, ploughing methods and date of sampling on the percentage of infested leaves, number of tunnels and live larvae per plant

Varieties	Ploughing methods	Date of sampling	% infested leaves/plant	No. of tunnels/plant	No. of live larvae/plant
Jazzera	**Control**	16/3	38.2	2.2	2.0
		25/3	25.2	1.8	0.8
	Chisel	16/3	33.7	3.7	1.6
		25/3	18.4	1.6	0.5
	Zero-till	16/3	29.9	2.9	0.2
		25/3	15.1	1.4	0
Rihan	**Control**	16/3	40.3	2.0	1.1
		25/3	28.6	2.1	0
	Chisel	16/3	35.1	2.5	0.8
		25/3	24.6	1.2	0.3
	Zero-till	16/3	38.7	4.0	0.7
		25/3	30.8	2.8	0

Results
A: After treatment with alpha cypermethrin insecticide, there was a decrease of live larvae for Jazzera barley after nine days. The number of larvae was 2.5 and 3.2 times more respectively in control and chisel at three days after treatment compared with after nine days.
B: Live larvae were absent in Rihan barley for control and zero tillage at nine days after treatment with the same insecticide, The relative number of live larvae was 2.6 times more after three days than after nine days.

Conclusions

These initial studies showed interesting differences in infestations of wheat leaf miner depending on variety and establishment method for wheat and barley. Generally, levels of infested leaves, number of tunnels and live larvae per plant were less under zero-tillage than chisel plough or farmer establishment for both wheat and barley. For wheat, Sham/6 often had less infestation than Om Rabee, Karunyia or Tell After/3. For barley, there were no consistent differences in susceptibility or infestation between Jazzera and Rihan. The insecticides Diazanon and Cypermethrin showed some effects in reducing leaf miner infestations and damage, with control increasing with time since spraying.

These results suggest that variety selection and crop establishment method can be useful in reducing leaf miner. Zero-tillage, which has many advantages, generally seemed to reduce leaf miner infestations and damage; perhaps this was related to stubble cover and lack of cultivation. These initial findings should be expanded on in the next few years with well-designed IPM research.

4. Cereal and legume crop research

Implemented by:
Staff Members of MOA in Ninevah

General Coordinator:
Dr. Salih M.Bader (MOA)

Report prepared and presented by:
Dr Adnan H Adary, Agricultural Research Department, Ninevah

Contents

4.1 Introduction

The activities during 2006-07 growing season included many diverse research projects which included cereals, food legumes, forage legumes and agronomy. The climate was described as a drought season with cold temperatures during January 2007 which affected the stand and establishment of the crops. The project activities encountered several obstacles regarding: financing, availability of equipment, transportation and security. However, the project managed to perform the activities assigned to it in one way or another with the support of local funds and resources.

ICARDA provided with thanks the germplasm for cereal, food legume and forage legume experiments. The assistance from the Australian collaborators in planning the activities especially in agronomy is greatly acknowledged. The above mentioned problems were solved with local support to secure good implementation of the program research activities.

4.1.1 Cereals

The program for cereals included the following activities:

4.1.1.1 Barley

4.1.1.1a The International Barley Yield Trial 2007. This trail was a replicated yield trail designed at ICARDA and comprised 25 entries with 2 replicates in a 6 x 6 lattice design. Details of the entries are listed in Table A.1.1. The experiment was completed and the data was given to Dr. Ceccarelli for statistical analysis and assistance in reporting the results and further recommendations. Details of crop performance are detailed in Table A.1.2. Several of entries (Assala-04, Arda/Moroc9-75) produced around 3000kg of biomass and over 1100kg/ha of grain.

Selection of barley lines was practiced for next season's planting. Farmer demands for 6-row black seeded lines were discussed with Dr. Ceccarelli who promised to include representative lines next season.

Table A.1.1 Entry details in the International barley yield trial – MRA (IBYT07-MRA set25)

IBYT07_MRA	NAME	PEDIGREE	SOURCE06	SN06	ORIGIN	FAOSTATUS	SC06	RTTH06
21	Assala-04	-	CHECKS06	28	ICARDA	U	W	6
2	Arda/Moroc9-75	ICB93-1136-0AP-5AP-0AP	IBYT07IN	2	ICARDA	U	W	2
17	N-Acc4000-301-80/IFB974//Alanda-01	ICB96-1087-0AP-7AP-0AP	IBYT07IN	18	ICARDA	U	W	6
14	Eldorado//Alanda/Hamra-01	ICB94-0189-0AP-18AP-0AP	IBYT07IN	15	ICARDA	U	W	6
23	Beecher	-	CHECKS06	29	USA	U	W	6
19	Manal/Alanda-01	ICB97-0936-0AP-14AP-0AP	IBYT07IN	23	ICARDA	U	W	6
11	Courlis/Rhn-03	ICB93-0923-0AP-5AP-0AP	IBYT07IN	12	ICARDA	U	W	6
16	Alanda//Lignee527/Arar/3/Alanda-01/Alanda-01	ICB96-0923-0AP-43AP-0AP	IBYT07IN	17	ICARDA	U	W	6
8	Lignee527/Chn-01/3/Arar//CompCr29/C63	ICB93-0946-0AP-23AP-0AP	IBYT07IN	8	ICARDA	U	W	6
12	Eldorado/3/NK1272//Manker/Arig8	ICB94-0162-0AP-9AP-0AP	IBYT07IN	13	ICARDA	U	W	6
3	Onslow/Tipper	ICB93-1159-0AP-15AP-0AP	IBYT07IN	3	ICARDA	U	W	2
10	Courlis/Rhn-03	ICB93-0923-0AP-2AP-0AP	IBYT07IN	11	ICARDA	U	W	6
18	Alanda-01/4/Gloria'S'/Saida//Mtn'S'/EH165/3/ LBIran/Una80//Lignee640	ICB97-0099-0AP-18AP-0AP	IBYT07IN	19	ICARDA	U	W	6
5	Lignee527/Rhn//Rhn-03	ICB91-0546-8SSD-1SSD-0SSD-3AP-0AP	IBYT07IN	5	ICARDA	U	W	6
15	Alanda//Lignee527/Arar/3/Alanda-01/Alanda-01	ICB96-0923-0AP-25AP-0AP	IBYT07IN	16	ICARDA	U	W	6
9	Rhn-03//Lignee527/As45	ICB93-0815-0AP-16AP-0AP	IBYT07IN	9	ICARDA	U	W	6
6	Hyb85-6//As46/Aths*2	ICB91-0736-0AP-0AP-0AP-4AP-0AP	IBYT07IN	6	ICARDA	U	W	6
7	Lignee527/Chn-01//UC566/Arbayan-01	ICB93-0830-0AP-15AP-0AP	IBYT07IN	7	ICARDA	U	W	6
13	Eldorado//Alanda/Hamra-01	ICB94-0189-0AP-5AP-0AP	IBYT07IN	14	ICARDA	U	W	6
20	Anoidium//Alanda/Hamra-01	ICB94-0157-0AP-11AP-0AP	IBYT07IN	24	ICARDA	U	W	6
4	Arta/3/Legia/Laurel'S'//Aleli	ICB97-0272-0AP-21AP-0AP	IBYT07IN	4	ICARDA	U	W	2
25	National_Check	Rihane-03	-	-	ICARDA	U	W	6
22	ER/Apm	-	CHECKS06	22	ICARDA	U	W	2
1	WI2737/4/Alger/Ceres//Sls/3/ER/Apm	ICB93-1091-0AP-30AP-0AP	IBYT07IN	1	ICARDA	U	W	2
24	WI2291	-	CHECKS06	17	AUSTRALIA	U	W	2

Table 2 Crop performance in the International barley yield trial – MRA (IBYT07-MRA set25) (Spatial Analysis)

IBYT07_MRA	NAME	ht	ph	by	till	hi	gy	rank
21	Assala-04	13.24	104.68	3255.32	220.5	0.15	1131.19	1
2	Arda/Moroc9-75	11.52	76.19	2832.78	220.5	0.18	1127.43	2
17	N-Acc4000-301-80/IFB974//Alanda-01	9.95	64.46	2435.10	220.5	0.18	995.59	3
14	Eldorado//Alanda/Hamra-01	11.79	77.87	2783.07	220.5	0.14	925.73	4
23	Beecher	7.85	81.22	2667.08	220.5	0.16	925.38	5
19	Manal/Alanda-01	9.69	84.57	2401.96	220.5	0.18	922.59	6
11	Courlis/Rhn-03	11.32	74.52	2683.65	220.5	0.14	893.76	7
16	Alanda//Lignee527/Arar/3/Alanda-01/Alanda-01	10.48	77.87	2468.24	220.5	0.15	878.49	8
8	Lignee527/Chn-01/3/Arar//CompCr29/C63	6.33	56.08	2418.53	220.5	0.16	854.91	9
12	Eldorado/3/NK1272//Manker/Arig8	9	56.08	3081.34	220.5	0.15	849.54	10
3	Onslow/Tipper	14.08	74.52	2642.23	220.5	0.15	839.42	11
10	Courlis/Rhn-03	11.63	51.73	3010.09	220.5	0.12	837.48	12
18	Alanda-01/4/Gloria'S'/Saida//Mtn'S'/ EH165/3/LBIran/Una80//Lignee640	8.01	82.9	2385.39	220.5	0.17	836.84	13
5	Lignee527/Rhn//Rhn-03	11.21	66.14	2650.51	220.5	0.16	824.50	14
15	Alanda//Lignee527/Arar/3/Alanda-01/Alanda-01	12.51	76.19	2658.8	220.5	0.15	802.54	15
9	Rhn-03//Lignee527/As45	12.01	82.90	2285.97	220.5	0.16	790.78	16
6	Hyb85-6//As46/Aths*2	13.35	57.76	2691.94	220.5	0.14	763.75	17
7	Lignee527/Chn-01//UC566/Arbayan-01	9.11	84.57	2759.88	220.5	0.12	763.49	18
13	Eldorado//Alanda/Hamra-01	12.47	82.9	2385.39	220.5	0.12	745.18	19
20	Anoidium//Alanda/Hamra-01	9.69	64.46	2401.96	220.5	0.17	739.02	20
4	Arta/3/Legia/Laurel'S'//Aleli	9.99	64.46	2600.8	220.5	0.15	724.72	21
25	National_Check	10.53	81.22	2526.24	220.5	0.16	665.81	22
22	ER/Apm	6.86	64.46	2559.38	220.5	0.14	599.48	23
1	WI2737/4/Alger/Ceres//Sls/3/ER/Apm	13.77	71.17	2092.1	220.5	0.22	510.09	24
24	WI2291	10.11	79.55	2352.25	220.5	0.16	470.42	25
Av SE		0.927	10.115	386.383	16.26	0.029	249.94	
Av SED		1.307	11.818	525.63	0.019	0.032	169.416	
CV%		13.21	19.63	35.1	34.74	29.65	44.61	

4.1.1.1b The International Barley Observation Nursery -2007. This nursery consisted of 100 lines with one replication. The nursery was planted at Rasheedya Experimental Farm with success in experiment management. Several selected barley lines which had good performance were obtained for next year's planting in the moderate rainfall areas. Dr. Ceccarelli advised to include and emphasise 6-row black barley materials for the moderate rainfall areas next season. These were represented in about 25% of the materials selected as having good promise and to be tested next season in replicated yield trails in the moderate rainfall areas at Telaskef and Telkafe areas.

4.1.1.1c Barley Nursery for Iraq 2007. This nursery included 100 lines for the low rainfall areas. It was conducted at Al-Rasheedya Experimental Farm with good management. However, a nearby explosion cause a fire in the nursery and no data was obtained. The nursery should be repeated next season, hopefully in the low rainfall areas of Telafer Station or Telabta. We have one set of the material and one more set is needed for next season's planting.

4.1.1.2 Durum wheat

4.1.1.2a Durum Wheat Yield Trial. This trial consisted of the following 8 varieties: Fadda98, Ammar9, Omrabi5, Waha, Laun/Hauk, Korfila, Garonia and Miki-2. The experiment was planted as a RCBD with 4 replicates. Experimental units consisted of 6 rows which were 2.5m long and 30 cm apart. The experiment reached maturity in good conditions. However, the field was exposed to an explosion which set the experiment to fire and no data could be collected. The trial should be repeated next season.

4.1.1.2b Durum Segregating Population -2005 DOS-5. This nursery consisted of 143 segregating durum wheat lines obtained from ICARDA. Each entry was planted in a one row plot 2.5m long and 30 cm apart. Spaced seeds were sown during the last week of December 2006. The nursery grew well and individual plant selection was practiced, among and within entries. Selection criteria included: plant height, spike characters, seed weight and yellow berry. These selections will be planted next season (2007-08). Some seed from these selections will be sent back to ICARDA for further quality evaluation.

4.1.2 Food legumes

The aim of food legumes projects was to implement food legume cultivation in about 500000 ha in the rainfed area. In addition to that there are 250000 hectares under supplementary irrigation in Iraq. This area is cultivated with winter cereals annually while most is left fallow after cereal harvest. The target is to replace fallow with food and feed legumes in addition to forage legumes (*Vicia sativa* and *Vicia narbonensis*) (Abbas, 1993).

Hussain and Al-Najar (1993) indicated that the best sowing date for forage legumes in the middle irrigated region of Iraq after rice is during the period from early to mid November, The best variety was Troy which was selected out of 9 cultivars. In the northern part of Iraq under rainfed and supplementary irrigation conditions, the best sowing time for eight cultivars of forage legumes (Troy, Gobo, Mindin, Maris Bead, Alfred, Faneta, Banner, and the indeterminate Tigo) was late October to early November. Troy and Mindin cultivars were superior in terms of yield and adaptation to environmental conditions in the area (Kasim et al. 1993).

4.1.2.1 Chickpea

4.1.2.1a Chickpea International Elite Nursery – Winter - 2007

Adnan H. Adary, Agriculture Research Department, Ninevah

Summary

Thirty one chickpea elite lines were tested in addition to five check lines. Seed was from ICARDA during the 2006-07 growing season. Materials were tested in a replicated 6 x 6 lattice design at Al-Rasheedyia Experimental Farm during the 2006-07 growing season. Sowing date was 23 December 2006. The experimental unit consist of a one row plot 4m long and 45 cm apart. Each row consisted of 60 seeds at 7.5 cm distance within row. Total rainfall within the season was 278 mm. A drought period occurred during January (plus cold temperature) and March (only 31 mm rain). Harvesting was done during the last week of May.

Chickpea International Elite Nursery-Winter-2007
Nursery Information

Nursery	Chickpea International Elite Nursery-Winter-2007		
Abbreviation	CIEN-W-2007		
Number of test Entries	31		
Number of Check entries	Five	a) ILC 482	- long term check
		b) FLIP 82-150C	- improved check
		c) FLIP 88-85C	- improved check
		d) FLIP 93-93C	- improved check
		e) Local	- local check
Total entries		36	
Number of replications	2		
Design	Simple Lattice (6x6)		
Number of rows/plot	1		
Row length	4m		
Row width	45 cm		
Total plot area	1.8 m2		
No. of seeds/plot	60		
Area of harvest	1 row (All plants within row)		
Data	Plant height, biological yield, grain yield, seed weight		

Results and discussion
Nine promising lines were selected: entries 20, 21, 23, 24, 25, 26, 27, 29 and 31. The check lines were entries 32 (ILC482), 34, 35 and the local check. Table B.1.1 presents some agronomic and yield characteristic of these lines. The characters studied were: stand (%), plant height (cm), biological yield (g/plot), seed yield (g/plot), seed weight (g/100 seeds).

Table B.1.1 Agronomic characteristics of selected chickpea entries from the International Chickpea Elite Nursery 2007.

No.	Entry	Name	Stand %	PLTH	BY	GY	SW100
1	20	FLIP 03-112C	25	30	175	20.5	17.7
2	21	FLIP 03-113C	37	35	300	37.6	15.7
3	23	FLIP 03-118C	18	30	150	18.5	14.8
4	24	FLIP 03-123C	20	33	150	21	15
5	25	FLIP 03-128C	18	28	100	11.8	12
6	26	FLIP03 -134C	26	30	250	24	18.2
7	27	FLIP O3-135C	33	35	50	9.8	8.8
8	29	FLIP 03 -141C	37	33	225	29	18.5
9	31	FLIP 03-144C	17	30	150	12	15.2
10	32	ILC482(Long term check)	45	40	350	19	13.1
11	34	FLIP88-85C (Check)	15	30	100	11	14.3
12	35	Flip93-93C (Check)	35	35	200	43	15.3

13	36	Local Check	3	25	50	0.5	12

Legend:
Stand %: Number of seeds planted/number of seedlings emerged
PTHT: Plant height (cm)
BY: Biological yield (g/plot)
GY/YLD: Grain yield (g/plot)
SW100: 100 seed weight

Stand (%)
In general the stand (% emergence from 60 seeds planted/row) was lower than 50% (range 3 to 45% in different lines). This might have been due to the low temperature during the period of germination and establishment in late December 2006 and January 2007. This is very important in the area where winter chickpea is intended to be grown in the future. The stand for the selected winter materials was much better than the local check 36 which is a spring type. Of the ICARDA lines, 21 and 29 gave the highest stand (37%). The check variety ILC482 was the best with a 45% stand.

Plant height
Selected lines gave a range from 28cm for line 21 to 35cm for line 27. The long term check ILC482 gave the highest plant height of40cm. This is very important aspect for the mechanical harvesting of chickpea in Iraq. The local variety gave the lowest plant height of 25cm.

Biological yield (g/plot)
The range of biological yield for different selected lines was 50g/plot for line 27 to 300g/plot for line 21. ILC482 gave the highest biological yield of 350g compared to the local check which produced 50g.

Grain yield (g/plot)
The range for grain yield was 9.8g for line 27 to 37.6 g for line 21. The improved check line 35 gave the highest yield of 43g. The lowest yield of 0.5g was for the local check. The rest of the lines were intermediate with respect to this important character. However, the drought period during March (31 mm) had a significant role in yield determination of chickpea in the region especially under moderate rainfall areas where the moisture reserves are low for winter sown types. It is of good potential to plan for the breeding program to cross the check line 35 with all selected lines and other checks and to look for both winter types and high yielding segregates in combination with large seed size.

Seed weight (g/100 seeds)
The highest seed weight of 18.5g was given by line 29, which was better than all checks cultivars. This is a very important character from the point of view of consumers in Iraq who like large seed types similar to Moroccan types. Similarities in seed size were noticed in lines 21, 23, 24, 26 and 31 (range 15 to 18.5 g). The best check cultivar was entry 36 with seed weight of 15.3g.

Recommendations
- the best lines were selected for good stand, plant height, biological yield, seed yield and seed size.
- for the important character of seed size, lines 20, 26 and 29 should be selected
- more crosses and selections are required among selected materials and checks
- advanced yield trials are necessary for the selected lines/checks in more than one location in the moderate and high rainfall areas of northern Iraq.
- seed quality should be evaluated.

4.1.2.1b Chickpea International Elite-LA-Nursery 2007

Adnan H. Adary, Agricultural Research Department, Ninevah

Summary
Thirty-one experimental lines and five checks of international elite chickpea nursery were tested during the 2006-07 growing season at Al-Rasheedya Experimental Farm. The total rainfall during the season was 278 mm. There were low rainfall periods in January (31mm) and March (31mm). Sowing date was on 25 December 2006. Each line was planted in a single row 4m long and 45cm apart with 60 seeds per row. Data were collected on stand, plant height, total biological yield, seed yield and seed weight per 100 seeds (g).

Fourteen lines were selected according to superiority in stand, plant height, grain yield and seed weight (Table B.2.1). These lines were 12, 33, 22, 4, 3, 35, 6, 17, 19, 16, 20, 2 and 29. The highest yielder was line 16 (64g) with good seed size. Recommendations are included with respect to the next season and new crossing program.

Table B.2.1 Selected chickpea lines from the International Chickpea Elite-LA-Nursery 2007

No.	Entry	Name	Stand (%)	PTHT (cm)	BY/plot (g/plot)	YLD (g/plot)	g/100 seeds	SN	HI (%)
1	12	FLIP03-22C	6.7	45	150	18	21.2	85	12
2	33	FLIP93-93C	16.7	40	100	2.1	19.1	11	2
3	22	FLIP03-110C	20	45	200	19.1	21.6	88	9.6
4	4	FLIP01-41C	43	26	150	27	14.6	185	18
5	3	FLIP01-29C	23.3	35	100	19	16.7	114	19
6	35	ILC464 (ck.)	20	35	50	11	13.6	81	22
7	6	FLIP02-07C	36.7	35	100	23.5	10.5	224	23.5
8	25	FLIP03-120C	35	55	50	17.3	14	95	26.6
9	17	FLIP03-100C	48.3	30	100	15	19.7	76	15
10	19	FLIP03-107C	36.7	35	50	15	17.2	85	30
11	16	FLIP03-60C	63.3	40	300	64	23.4	274	21.3
12	20	FLIP03-108C	50	30	300	23	15.9	145	7.7
13	2	FLIP01-26C	25	40	200	20	14.3	140	10
14	29	FLIP03-137C	30	35	50	11.2	16.2	73	23.6

Legend:
Stand %: Number of seeds planted / number of seedling emerged
PTHT: Plant height (cm)
BY: Biological yield (g/plot)
YLD: Grain yield (g/plot)
SW100: 100 seed weight
SN: Seed number per plot
HI: Harvest index (%)

Stand
Stand was lower than 50% for most lines except line 16 (68%). Entries/lines 4, 3, 6, 25, 17, 19, 20, 2, 29 and 20 gave good stands of 20 to 50%. This is a very important aspect related to yield. Stand could be affected by low temperature during germination and emergence periods during January as happened

during the season. Entries with good adaptation to low temperature like no.16 have the genetic potential for good stand establishment that is reflected in higher yield (23.4g). Breeding methodology for selection of lines with better speed of germination is important for winter sown chickpea in the region and it could be beneficial to enrich Iraqi germplasm with this important character in entries 4, 6, 25, 17, 19, 16, 20 and 29.

Plant height
The range of plant height for selected entries was 26 to 55cm. Very good plant height (>40 cm) was observed for entries 33, 22, 25, 2 and 16, and these should form the basis of parental material for the crossing program. The rest of the entries (3, 35, 17, 19, 20, 29 and 20) were in the range of 30-35cm. Height is important for mechanical harvesting in Iraq, especially if combined with a correspondingly high first pod height.

Biological yield
The highest biological yields (300g) were from entries 16 and 20. Lines 22 and 2 gave 200g and the remaining 11 lines gave 50 to 150g. Lines with high biological yield gave higher grain yield (lines 16 and 20) but with lower harvest indices. This aspect should be rationalized with the available moisture during the season.

Grain yield
The highest yielding lines were 16, 6, 12, 22, 22, 3, 20 and 2, with a yield range of 18 to 64g. That is a good level compared to the local variety (36). The yield levels attained could be enhanced by further crossing and selection at different generations. More evaluation of the selected materials is required under moderate and high rainfall areas. It is very important to evaluate G X E interactions.

Seed weight
This character is important for Iraqi consumers and is reflected in farmer desirability to plant new large-seeded cultivars. The highest seed weight was attained by the lines 12, 22 and 16, which gave weights of 21.2, 21.6, and 23.4g respectively. The seed weight/size is critical in Iraq at the present time for marketing and needs further consideration. Crosses with the local lines are required to enhance selection for improved seed size in the newer varieties, similar to the Morrocan type in the region.

4.1.2.2 Faba bean

4.1.2.2a Faba Bean International Improved S1 Populations Nursery 2005-06 and 2006-07

Dr. Adnan H. Adary, Department of Agricultural Research, Ninevah

Introduction
Faba bean is one of the important field crops in Iraq. It is planted in all areas of Iraq in both irrigated and rainfed systems. Traditionally, faba bean is planted from October to the end of November in northern Iraq under high rainfall conditions. The rate of seeding is 120 kg/ha for the local variety.

A faba bean F3 S1 population was received from ICARDA in the 2005-06 growing season and testing was repeated in the 2006-07 growing season. The experiments went well and produced good results.

The nursery consisted of 5 S1 populations; names, pedigrees and sources are presented in Table B.3.1. Three check varieties were used. The design of the experiment was a RCBD with three replications. The eight lines were planted in plots with 4 rows, which were 4m long and 50cm apart. Planting was in hills 20cm apart within the row, with one seed in each hill at 6cm depth. Climatic parameters are presented in Table B.3.2. The nursery was grown under rain fed conditions, with one supplementary irrigation during

March 2006. Sowing dates were 15 January 2006 and 17 December 2006. Flowering started on March 21 and maturity was during the last week of May. Harvest was in the first week of June. Data were recorded for the two middle rows (5 plants taken at random) for:

- Branch number per plant
- Pod number per plant
- Seed index (weight per 100 seeds)
- Biological yield (g/plant)
- Seed yield (g/plant)

Statistical analysis of the data was undertaken according to the design used (RCBD) using the INSTAT statistical package. Results are presented in Table B.3.3 and Figure B.3.1.

Results and Discussion

2005-06 growing season

Climate

Table B.3.2 presents the climate parameters for the season 2005-06. The season started in December with 11.2mm. It was wet during January (142.7mm) and February (134.7mm) which caused flooding in the experimental area and low plant stands in replicates 1 and 2. March was dry (21.9 mm). However, the season finished well with good rains during April (94.7 mm) which saved the crop. The minimum temperature occurred in late December and January and it was around zero during a 4-day-period in late December. The maximum temperature was good for normal growth during March and April but high during May and June

.

Seed Yield (kg/ha)

The seed yield of all entries exceeded the local entry. Line 3 gave the highest grain yield (2001kg/ha) then line 6 (1642kg/ha) and line 2 (1446kg/ha). The local line gave the lowest seed yield (990kg/ha).

Seed index (g/100 seed)

Entries 1, 6 and 7 gave the highest seed weights of 77, 97 and 92g respectively. The large seeded types are desirable for Iraqi consumers for direct boiled seed and green pods consumption. For these reasons farmers continue to plant the large seeded types although they are lower in yield compared to small seeded types. The small seeded types are suited for preparation of the well known dish for human consumption called “Fool Mudamas” or for use as forage legume crops and animal feed for poultry. Entry 3 which is a small seeded type (60 g) but gave the highest seed yield (2001kg/ha) could be utilized for such purposes.

Other studies are required for the small seeded types in order for full expansion of broad bean cultivation in Iraq. It is considered that high yield, small seeded types will be important because they have good potential for mechanization of planting and harvesting the crop in Iraq.

Table B.3.1 Names and pedigree of Faba Bean International S1 Populations

Entry No.	Name	Pedigree	Origin	FAO Status
1	HBP/S0A/2005	20Crosses (Bot. x Asc. x EM x L.Tan)	ICARDA	U
2	HBP/S0B/2005	20 Crosses (Bot. Asco. x Oro)	ICARDA	U
3	HBP/S0D/2005	28 Crosses(Incorp Bot. x Asco.)	ICARDA	U
4	HBP/S1C/2001-F6	19 Crosses (Bot. x Asc.)	ICARDA	U
5	HBP/S1D/2001-F6	24 Crosses (Bot. x Asco. x Oro)	ICARDA	U
6	ILB1814	Syrian local large	Syria	D
7	ILB1266	Aqua Dolce	Spain	D

8	Local Check	Iraqi	Iraq	U

U = Undefined, D= Designated

Table B.3.2 Climate parameters at Al-Rasheedya site during 2005-06 and 2006-07 growing seasons

Days	Month	T. Max.	T. Min.	Days <0°C	Days With Snow	RH Max.	RH Min.	Rainfall 2006	Rainfall 2007
1-15	October	34.19	16.5	0	0	56.4	19.6	0.0	0
16-31	October	27.59	10.81	0	0	60.31	22.63	0.0	27
1-15	November	23.2	6.81	0	0	70.27	28.3	0.0	1
16-30	November	21.27	7.05	0	0	84.13	46.4	0.0	9
1-15	December	23.29	6.64	0	0	83.15	0.0	0.0	0
16-31	December	14.08	4.56	4	0	95.81	0.0	11.2	45
1-15	January	13.1	4.19	0	0	77.87	61.93	101.6	19
16-31	January	10.81	3.02	1	0	94.13	61.75	41.1	4
1-15	February	14.22	7.32	0	0	93.2	-	134.2	56
16-28	February	16.57	5.48	0	0	86.1	-	0.5	25
1-15	March	20.91	8.35	0	0	85.33	38.6	1.4	7
16-31	March	21.70	8.56	0	0	88.81	43.78	20.5	24
1-15	April	24.5	12.51	0	0	90.6	46.6	33.9	34
16-30	April	25.87	16.01	0	0	87.8	46.0	60.8	0
1-15	May	30.51	16.35	0	0	81.2	35.33	0.0	7
16-31	May	35.76	18.49	0	0	61.38	22.0	0.0	0
Total								433	258

Station Location: Longitude: 43 ; Latitude: 36 ; Altitude: 223m

Table B.3.3 Performance of faba bean S1 populations planted at Al-Rasheedya during the 2005-06 growing season

Entry	Name	HD (days)	MD (days)	PLTH (cm)	Yld (kg/ha)	SI (g/100 seeds)
1	HBP/S0A 2005	76	131	56.7	1371	77
2	HBP/S0B 2005	76	131	51.2	1446	64
3	HBP/SOD 2005	76	131	56.7	2001	60
4	HBP/S1C/2001-F6	76	131	60.3	1173	67
5	HBP/S1D/2001-F6	76	131	64	1212	64.8
6	ILB 1814	76	131	52	1642	97.1
7	ILB/1266	76	131	65	1313	91.7
8	Local check	76	131	76	990	57.7

HD = Heading date
MD = Maturity date
PLTH = Plant height
YLD = Seed yield
SI = Seed index (g/100 seeds)

2006-07 growing season
Summary

In the 2006-07 growing season the same experimental design (RCBD) was used to evaluate the 8 genotypes of faba bean under rainfed conditions in the moderate rainfall area represented by Al-Rasheedya station. All agronomic protocols applied in 2006 were applied during 2007 except sowing date was 17 December 2006. Crop performance results are presented in Table B.3.4 and, for seed index, in Table B.3.5.

Climate:
Rainfall during the 2006-07 season was 258 mm (Table B.3.2). Good rain was recorded in the second half of December and February. However, total rainfall was much less during 2006-07 than 2005-06 (433 mm) and the low crop yields in 2006-07 were no doubt related to low rainfall.

Stand %
No significant stand differences between entries were observed, with stands ranging from 30% for ILB1266 to 40% for local. These values are low and no doubt contributed to the low levels of seed yield. The low stand numbers resulted from both low temperature and low soil moisture content especially in the upper soil zone which contained the seed. Sowing date was 17 December 2006. It is known that both December and January are the coldest months of the year in the region and this might have affected germination and establishment of all varieties. However, the irregularity in the onset of the first effective rain (Balla) can affect crop establishment. If the balla comes early in October or November, sowing date for faba bean can be early with warmer temperatures for seed germination and establishment. Sowing date can be adjusted if there is access to supplementary irrigation, and this should be studied in connection with sowing date of faba bean in the region. An alternative solution is to develop cold tolerance varieties to allow later planting of faba bean.

Flowering time:
Flowering time was similar in all varieties and occurred 14 days after the first of March. The lack of variability in flowering time among these populations means they are not useful in breeding for varying maturity times. However, further selection for this trait in advanced segregating generations might give variability in this important trait.

Plant height:
Plant height was not significantly different between entries and ranged from 25cm for entry 2 to 31cm for entry 5.

Biological yield
The lines differed significantly in biological yield. The range was 516.7 g for line 4 to 1120.3 g for line 1. The ILB check varieties gave intermediate values of 766.7 and 733.3 g/plot whilst the local small-seeded type gave 600 g/plot.

Seed yield
The differences in seed yield among lines were significant. The highest yielding line was entry 1, which gave 321 g/plot or 893 kg/ha. This was about twice that of the local entry, which produced 147 g/plot or 408.3 kg/ha). ILB 1814, a large seeded variety, gave 180 g/plot or 500 kg/ha. The other lines were intermediate in yielding capacity. However, these yields were much lower than for last year, perhaps due to the higher total rainfall and better distribution of rain during 2005-06 than 2006-07. The total rainfall during January and February in 2006 was 142.7 and 134.7 mm, respectively. These levels were favorable for seed germination and establishment, resulting in good seed yield for the nursery.

Seed index (g/100 seeds)
The highest seed index of 79.3g was for entry 4, whilst LB 1814 and Aquadolci (ILB 1266) were 78.7 and 72.7g respectively (Table B.3.5). These values indicate medium size seed. However, lines 1, 2, 3, 5

and 8 were small size category and the differences were significant. These 2006-07 seed indices generally were lower than in 2005-06.

It is important to indicate that local consumer preference is for large seeded varieties such as ILB 1418 and ILB 1266; line 4 might be useful in breeding programs with these varieties. For large scale, mechanized farming systems, it is considered better to go for small seeded lines; entry 1, which also had high grain yield, might be useful in crossing and this will be considered for further investigation.

Table B.3.4 Performance of different faba bean lines tested during 2006-07 at Al-Rasheedya station

Entry	Name	Stand (%)	FLTIM	PTHT (cm)	BIO (g/plot)	YILD (g/plot)
1	HBP/S0A/2005	37.3	14	27.5	1120*	321.7*
2	HBP/S0B/2005	36	14.3	25.0	583.3	169
3	HBP/S0D/2005	35.7	14	26.7	383.3	164.4
4	HBP/S1C/2001-F6	35.7	14	30	516.7	97.7
5	HBP/S1D/2001-F6	32.3	14	31.7*	933.3*	173.7
6	ILB1814	36.7	14	30	766	180*
7	ILB1266	30.3	14	28.3	733.3	163
8	Local	39.7	14	28.3	600	147
	SE mean	1.422	0.1179	2.453	133.6	25.42
	SE mean Dif.	2.011 N.S	0.1667 N.S.	3.469 *	189.6 *	35.95 **
	F Lines	1.6	1	0.7	3.1	6.3

Table B.3.5 Seed indices (g/100 seeds) for 2006 and 2007 growing seasons

Number	Name	2006	2007
1	HBP/S0A/2005	77	64
2	HBP/S0B/2005	64	53.3
3	HBP/S0D/2005	60	51.7
4	HBP/S1C/2001-F6	67	79.3
5	HBP/S1D/2001-F6	64.3	63.0
6	ILB 1814	97.1	78.7
7	ILB 1266 (Aquadolci)	91.7	72.7
8	Local	57.7	60.3

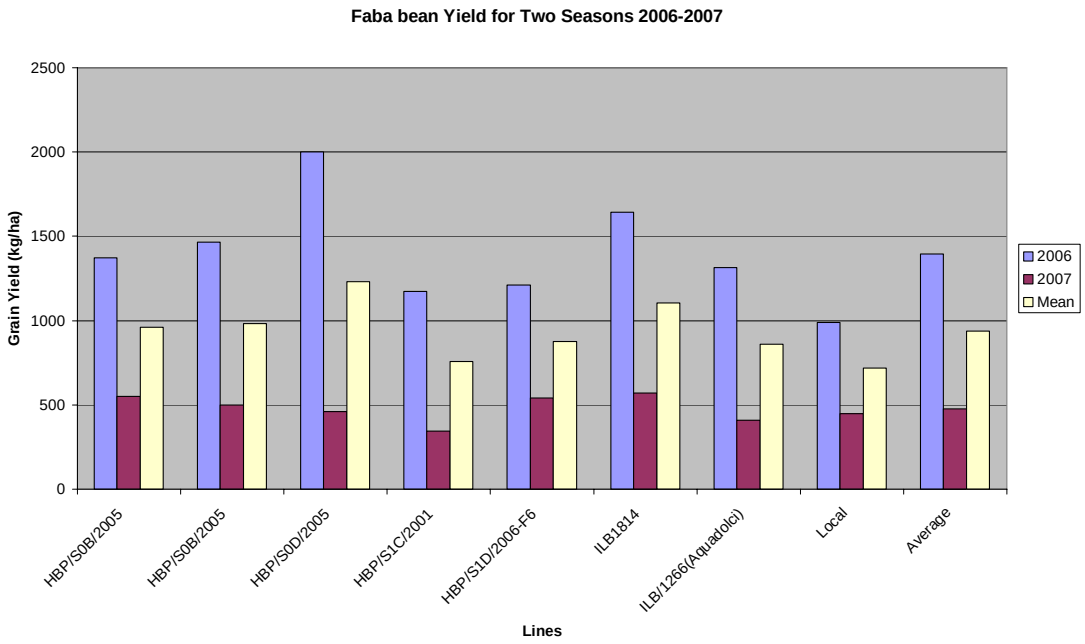

Figure B.3.1 Seed Yield for Faba bean lines grown in 2006 and 2007 growing seasons at Al-Rasheedya

Lesson Learnt and Implications for 2006/7 Planning

1. Major constrains:

- Man power needed
- Security
- Lack of Logistics – transportation
- Need for movable fences to protect experiments
- Seed storage
- Seed production for elite varieties
- Market distortion (unfavorable marketing environment due to very low prices of imported produce)
- Reluctance to use fertilizers
- Changes needed for improved efficiency in project implementation
- Change from public to private vehicles for project work
- Need to concentrate on timely sowing
- Timely harvesting to avoid grazing by sheep
- Rebuild the poultry industry based on small-seeded faba bean genotypes
- Seed containers
- No cold tolerance nursery
- Supply of large-seeded chickpea.

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4.1.3 Agronomy

4.1.3.1 Effects of tillage and crop rotation on durum wheat production and quality

Adnan H. Adary, Saad T.Al-Malak, Ali J. Alaila

Summary
Durum wheat (*Triticum turgidum* var. *durum* Desd.) is an important cereal crop in Iraq. It is a staple food especially in northern parts of the country. The area devoted to durum wheat production is around 10% of the total area for wheat production in Iraq (about 25 thousand hectares). The average yield per unit area is around 1000 kg/ha. However, under supplementary irrigation and use of good agriculture technology and modern cultivars like Waha and Omrabi5, the yield could reach over 4000 kg/ha. The main areas of durum wheat cultivation are under moderate and high rainfall areas of northern Iraq such as Alkosh, Sharafya, Al-Shikhan, Telkaf, Basheeka, Nimrood, Hamdanya, Telfer, Zumar and Rabiaa. Durum wheat is also successful under irrigation in Nineveh, Kirkuk and Baghdad but it needs more chemical fertilizers to produce vitreous kernels suitable for local food making. In practice, yield in general is low due to constraints with drought, weeds, soil management, fertilizers, varieties and availability of high quality seeds for planting. Many new varieties are available but seed is very limited due to the lack of successful seed programs.

The objective of this research was to develop technology packages that enhance yield of durum wheat through improve tillage and soil fertility management and physical properties through raising organic mater and crop rotations with food legumes.

Materials and Methods
A split plot experiment was started at Al-Rasheedya during the 2006-07 growing season. The main plots consisted of three tillage systems: deep tillage with mold board plow (MB), conventional tillage with chisel plow (CP) and the no till system (NT). The split plots consisted of added straw (500 kg/ha) at planting and no added straw. The number of replicates was two. The durum wheat variety used was Omrabi5 sown at 120 kg/ha of seed. Sowing date was 24 January 2007. The experiment was grown under rainfed conditions in this moderate rainfall area. Soil analysis was undertaken.

The no till treatment was established manually by opening rows with a simple row opener on untilled land and then the seeds were drilled by hand and covered. The experimental unit/plot consisted of 50 rows each 2.5 m long and 30 cm apart. Straw was applied with the seeds in each row at a rate of 500 kg/ha. Each row received urea (45% N) and triple super phosphate (46% P) at a rate of 160 kg/ha. Harvest was done manually during the first week of June. Data were collected on the biological yield, grain yield, head number, plant height, seed weight (1000 seeds) and yellow berry. These data were estimated from random samples from each plot and analyzed according to the design used (split plot) using the INSTAT computer software.

Results and Discussion

Climate and soil characteristics
Table 1 presents the rainfall and some climatic parameters during the 2007 growing season. The total rainfall was 258 mm. Rainfall was low in January (31mm), good in February (81mm) and low during March and April. Temperature was low during January especially the minimum temperature (the range was from 1.21ºC to 3.57 ºC) which might have caused the low stand % in the field. Hot weather was

encountered during April and May accompanied by hot wind during the heading and grain filling periods at Rasheedya.

Soil analysis was carried out by the Soil and Water Laboratory before the experiment was established (Table 2). The soil texture was clay and pH was 7.2. Salinity ranged from 0.987 to 4.636 mmohs/cm with one sample giving 10.72 mmohs/cm. The available P was in the range of 30 to 78 ppm in different samples. Organic matter was in the range of 1.16 to 1.42%.

Table 1 Climatic records during 2007 growing season at Al-Rasheedya Experimental Station.

Month	Temp. max	Temp. min	RH. max.	RH.min.	Rainfall mm
Oct.1-15					0
Oct. 16-31					27
Nov. 1-15					10
Nov. 16-30					-
Dec. 1-15					-
Dec. 16-31					45
Jan. 1-15	9.42	3.57			22.6
Jan. 16-31	14.7	1.21			4.7
Feb. 1-15	14.07	3.94			56
Feb. 16-28	15.71	6.39			85
Mar. 1-15	19.6	7.13			7
Mar. 16-31	18.8	14.65			24
Apr. 1-15	21.2	9.3			31.9
Apr. 16-30	23.63	10.56			6.8
May. 1-15	32.8	17.77			7
May 16-31	36.93	21.42			1.2
Total					328

Table 2 Analysis for soil of Al-Rasheedya station during 2007 growing season

No.	Texture	pH	Salinity mmoh/cm	P ppm	OM %
1	Clay	7.2	0.987	78	1.164
2			3.245	20	1.232
3			4.636	45	1.301
4			2.6	42	1.43
5			10.72	49	

Wilting point 31%

Grain Yield

Figure 1 presents the yield data for tillage, straw and tillage X straw interactions during the 2007 growing season. The mold board tillage (MT) gave the highest grain yield (1592 kg/ha) compared to conventional tillage (CT) or no tillage (NT). The later technology gave the lowest yield (478 kg/ha). It seems that the deep tillage in this experiment conserved more moisture that secured the stand and led to higher yield.

For straw, the effect of adding straw during this season was not significant on wheat yield, with straw plus giving a mean yield of 863kg/ha and straw minus giving 875kg/ha. The lack of a straw effect might

be due to insufficient time for bacterial activity to work on straw. Probably the situation will be improved next season.

It appeared that the MT treatment gave the highest grain yield (1729 kg/ha) with straw plus.but the interaction effect of tillage X straw was not significant. However, as mentioned before, there was likely not enough time for the added straw increase soil organic matter levels or mobilize nitrogen in the soil – this needs further investigation. The effects of crop rotation from sowing lentil after wheat will be studied next season (2008) where lentil will be planted after wheat.

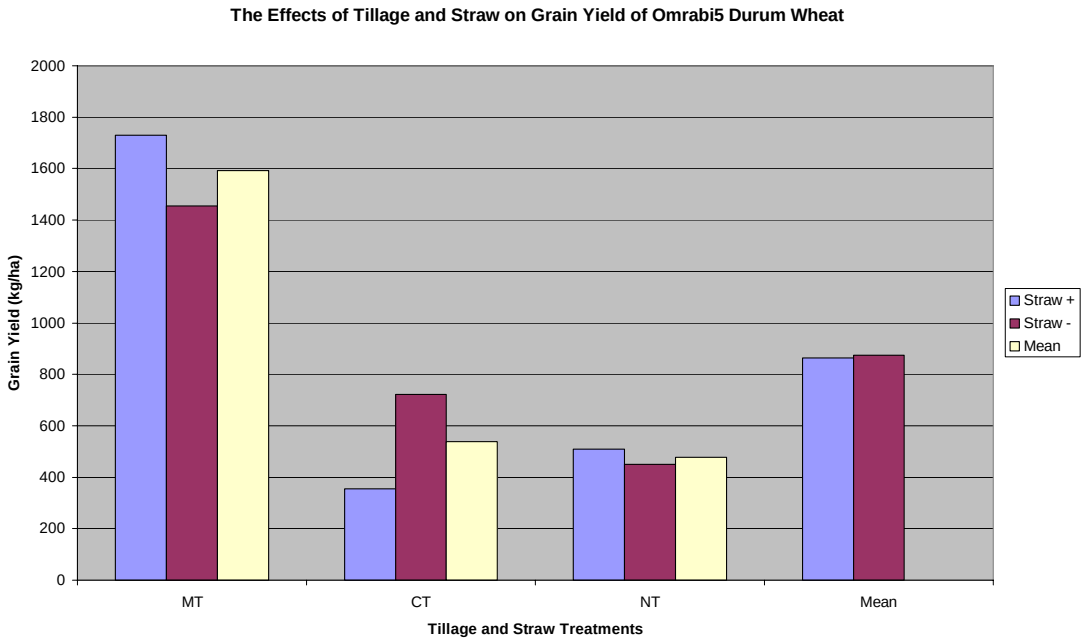


Figure 1 The effects of tillage and straw treatments on grain yield of Omrabi5 durum wheat during 2007 growing season.

Biological Yield

Deep tillage (MT) gave the highest biological yield (6126 kg/ha) and the differences were highly significant (Figure 2). The (CT) and (NT) gave 1366 and 1319 kg/ha respectively and the difference was not significant. The straw plus treatment gave higher biological yield (3427 kg/ha) compared to the straw minus treatment (2447 kg/ha). For the interaction of tillage X straw the differences were significant especially for the MT and straw plus interaction (7503 kg/ha). The other levels of this interaction were not significantly different.

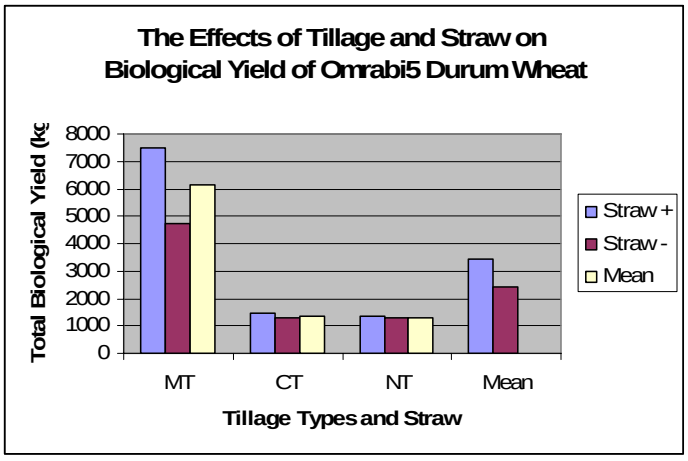


Figure 2 The effects of tillage and straw on biological yield of Omrabi5 durum wheat

Harvest index

The harvest index (%) differed significantly according to the tillage practices (Figure 3). No-till gave the highest harvest index compared to the other practices. This is an indication of low biological yield or straw compared to the MT method. The straw plus treatment gave a lower harvest index (27%) compared to the straw minus treatment but the difference was not significant. For the tillage x straw interaction, the highest value for harvest index (33%) was given by the NT treatment under straw plus treatment. The lowest value was 21% under MT and straw plus treatment. This is an indication of high biological yield in the MT treatment. Under the straw minus treatment, both MT and CT treatments gave comparatively the same harvest indices.

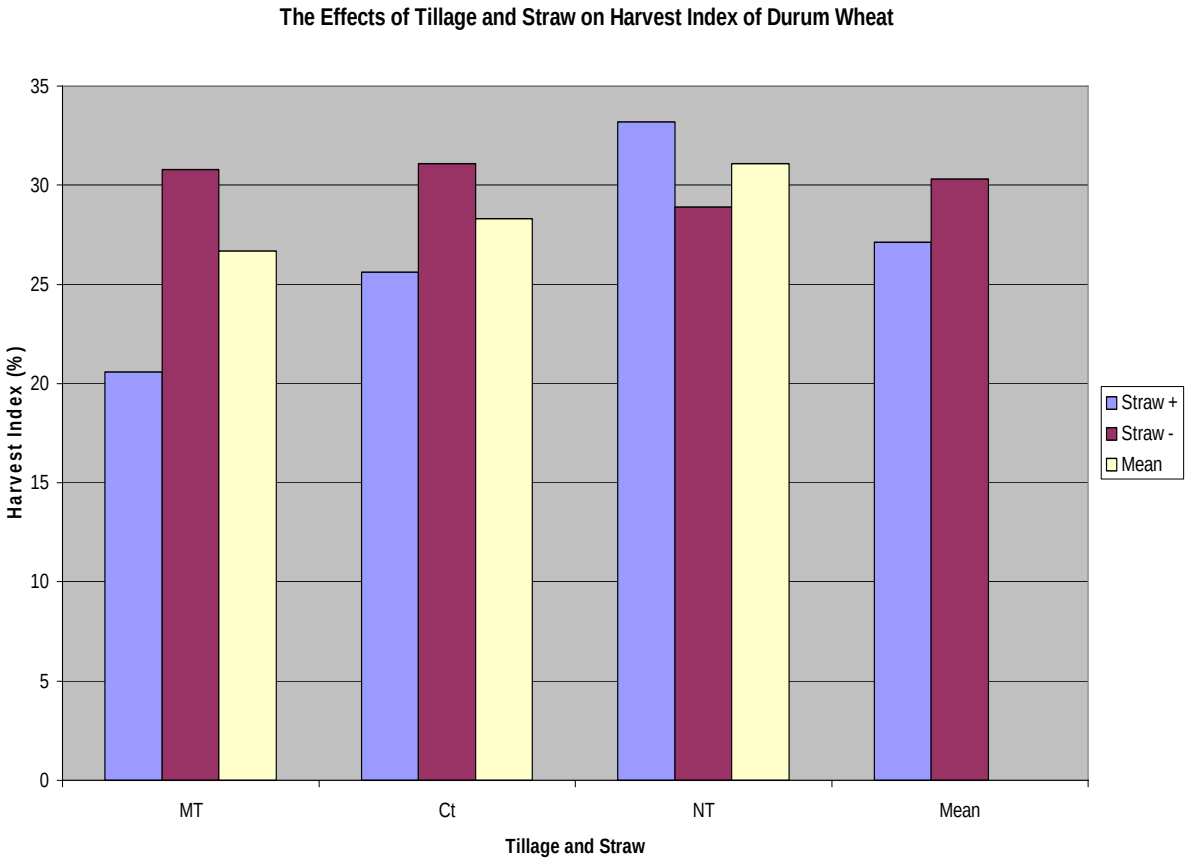


Figure 3 The effects of tillage systems and straw treatments on harvest indices of Omrabi5 Durum Wheat during 2007 growing season

Seed Weight (g/1000 seeds)

The CT treatment gave significantly the highest seed weight (35.8g) compared to NT (29.7g) (Figure 4). The straw minus treatment gave higher seed weight (34.1g) compared to straw plus treatment (31.4g). The highest seed weight (38g) was given by the interaction of CT and the straw minus treatment. The seed weight of NT was lowest under both straw plus and straw minus treatments.

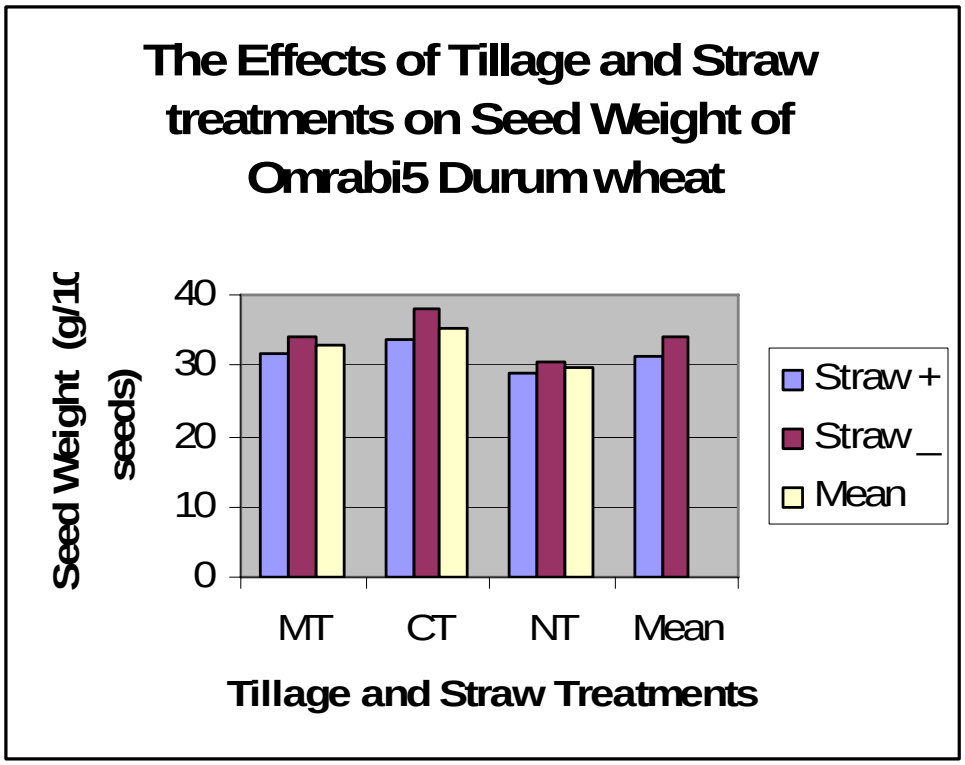


Figure 4 The effects of tillage and straw treatments on seed weight of Omrabi5 durum wheat during 2007 growing season.

Plant height (cm)
The highest plant height (86cm) was given by the MT treatment (Figure 5) and the lowest (70cm) was from the NT treatment and the CT treatment was intermediate (79.7cm). The difference between the straw treatments was not significant (72.5 and 78.6 cm).

The interaction of tillage x straw treatments was not statistically significant. However, the MT system gave the highest plant height under both straw treatments (88.8 and 83.3cm). The lowest values were obtained from the NT and Straw plus (67.5cm) and straw minus (72cm) treatments.

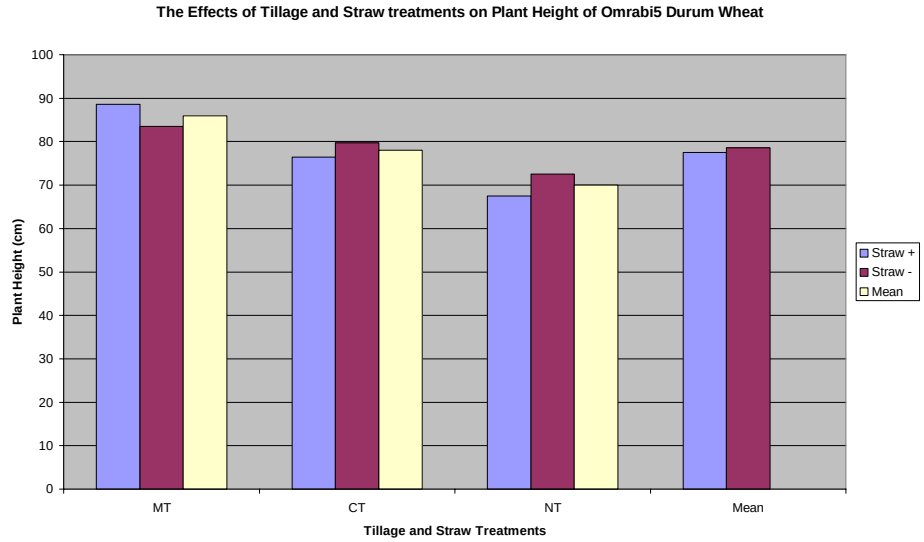


Figure 5 Effect of tillage system and straw treatment on plant height of Omrabi5 durum wheat.

Recommendations:
In the 2007-08 season:

- the experiment should be continued using lentil
- the no-till machine should be used to sow the NT treatment
- an earlier planting date in the last week of November/first week of December should be used
- pre-emergence herbicides should be used, especially for NT
- the straw treatment should be applied on the field in sufficient time prior to planting.

5. Supporting research at ICARDA

Atef Haddad, Colin Piggin, Juergen Diekmann, and Mustafa Pala.

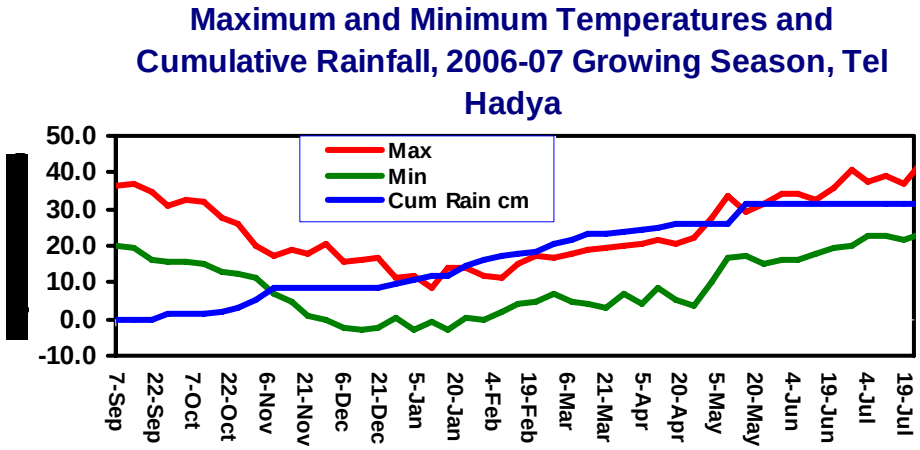
Several studies were conducted at the ICARDA Tel Hadya research station to provide information and seed multiplication to support the crop improvement and agronomy work in Ninevah. Background and results from these studies are briefly presented below. They were all conducted by the agronomy and station operations groups.

5.1 Agronomy

In agronomy studies at ICARDA linked to the Iraq project, four trials comparing zero-tillage and conventional cultivation for establishment of oats, wheat, chickpea, and barley using the Indian zero-till planter and three trials on adaptation/seed increase of Australian-supplied oilseeds, peas and oats were conducted in 2006-07. These continued zero-till and adaptation research commenced in 2005/06. These are giving good information for developing new systems of conservation cropping (zero-tillage, stubble mulching, rotations) and have proven valuable for training of Iraqi visitors.

5.1.1 Weather and attainable yield

Rainfall and temperature at ICARDA for 2006-07 are detailed below. Rainfall from 22 Sept 06 to 20 May 06 was 315mm.



Using information from Water Use Efficiency (WUE) studies (Sadras & Angus 2006), attainable grain yields from wheat and chickpea were around 5 and 1.6 t/ha respectively, calculated as follows:

Attainable yield = available moisture x WUE

- wheat = (315mm – 60mm) x 20kg/mm = 5.1 t/ha
- chickpea = (315mm – 110mm) x 8kg/mm = 1.6 t/ha

Actual yields would have been reduced below these levels by a range of weather constraints such as lack of rain in the13 Nov-28 Dec period, frosts in the 6 Dec-28 Jan period and on 27 April, and high temperatures of 40 degrees in July. Yields would have also been lowered by soil and crop management constraints (Anderson et. al 2006, Passiora 2006).

The difference between attainable and actual yields is a useful guide on variety selection and/or soil and crop management.

5.1.2 Zero-tillage research

Objective: To evaluate alternative crop establishment techniques in Mediterranean environments

Four experiments were undertaken – these were:
1. Oats on wheat stubble (Field C5)
2. Chickpea on wheat stubble (Field C5)
3. Wheat on lentil stubble (Field C16)
4. Bread and durum wheat, chickpea, lentil on chickpea stubble (Field B4)

Large plots were used to simulate farming systems more realistically.

5.1.2.1 Experiments 1 and 2: Zero-till oats or chickpea after wheat (Field C5)

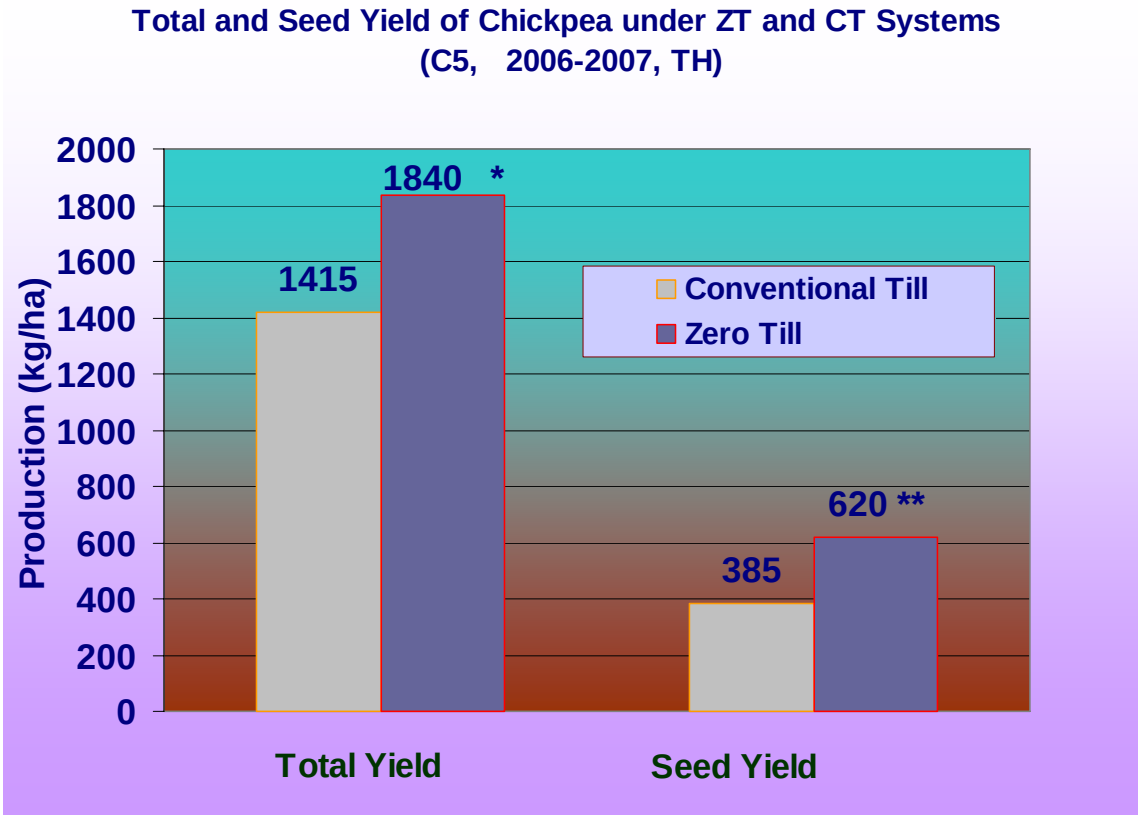
Treatments: Zero-till or Conventional tillage
Plot size: 24 x 800m
Replicates: 2
Design: randomized complete block (2 x 2)

Land preparation and crop management

Treatment	Operation	Implement	Date	
			Oats	Chickpea
CT	Plowing	Moldboard	Summer	
	Cultivation	Limken sweep	9/11/06	27/11/06
ZT	Herbicide	Touchdown	9/11/06	25/11/06
CT	Planting	Indian ZT seeder	10 and 11/11/06	27 and 28/11/06
ZT	Planting	Indian ZT seeder		
CT	Harvesting	Hege combine	14/6/2007	
ZT	Harvesting	Hege combine		

The total yield (biomass) and grain yield of chickpea were significantly higher under ZT than CT.

There was also some indication that yield of chickpea under ZT was not depressed by residues of "Monitor", a sulfonylurea herbicide used to control broadleaf weeds in the previous wheat crop which can persist over summer in alkaline soils when rainfall is low, whilst it was depressed under CT. This probably reflected the fact that soil was not mixed to depth in the ZT plots and the seed was sown beneath any "Monitor" layer.



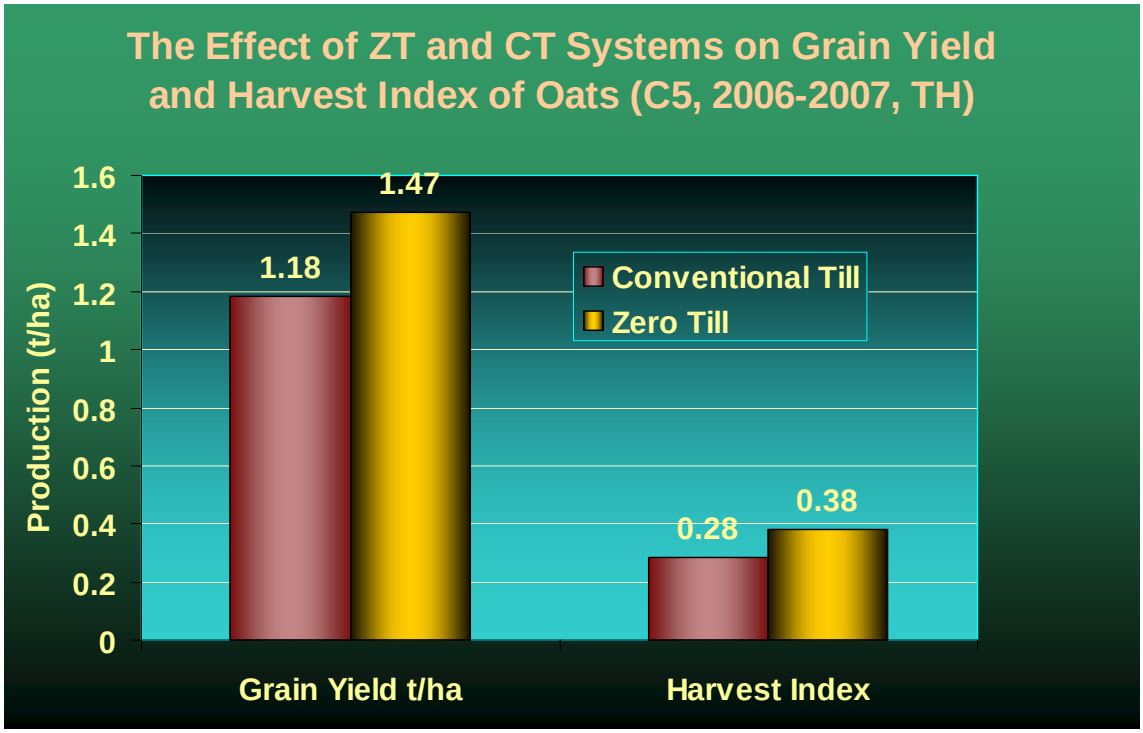
Total yield LSD 5%=294; Seed yield LSD 5%=66

Grain yield (kg/ha combine harvested) of chickpea on wheat stubble +/- monitor*

	- monitor	+ monitor	Diff
CT	505	270	235
ZT	650	590	60
Diff	145	320	
LSD 5%			93

* Sulfonylurea herbicide for control of broadleaf weeds in cereals

For oats, grain yield and harvest index were higher under ZT than CC, although these differences were not significant.



Grain yield NS (LSD 5%=0.81; Harvest index (NS LSD 5%=0.76)

5.1.2.2 Experiment 3 Zero-till wheat after lentil (Field C16)

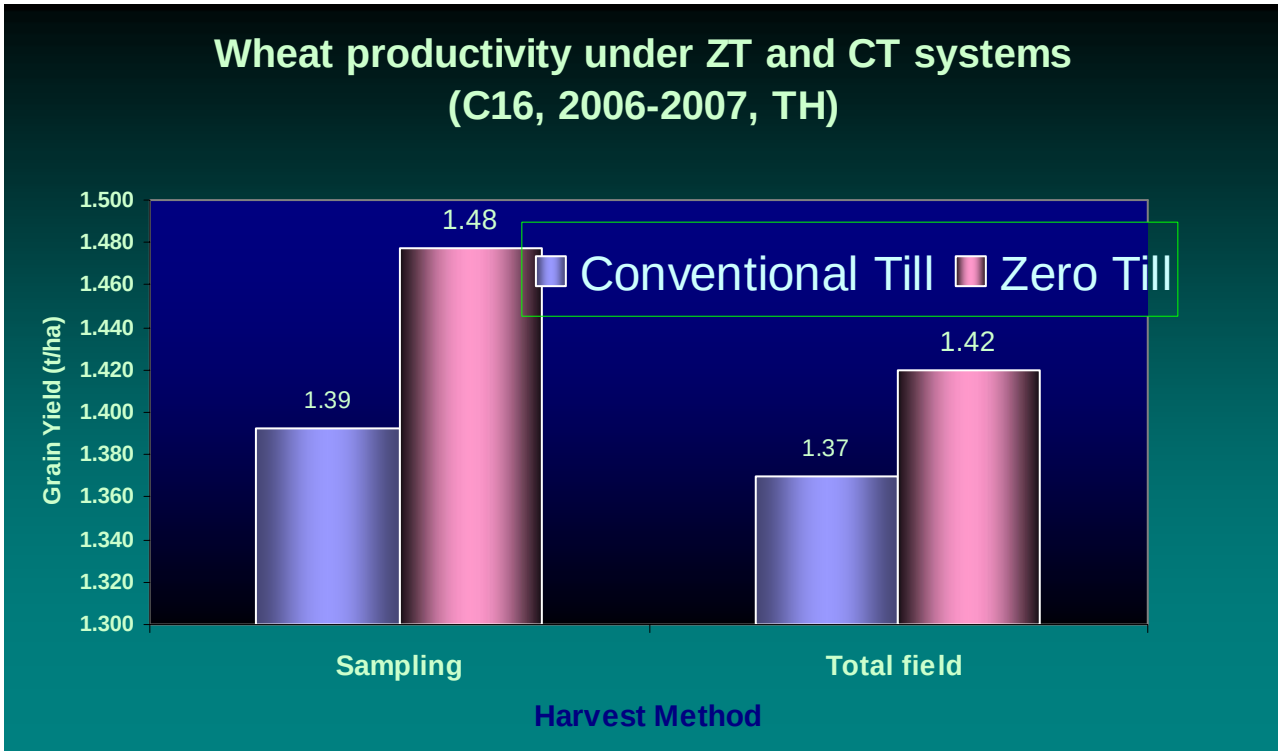
Treatments: Zero-till or Conventional tillage
Plot size: 48 x 400m
Replicates: 3
Design: randomized complete block (2 x 3)

Land preparation and crop management

Treat	Operation	Implement	Date
CT	Cultivation	Amazone cult.	9 Nov 2006
ZT	Herbicide	Touchdown	9 Nov 2006
CT/ZT	N-Fertilizer	30 N as Urea	10 Nov 2006
CT/ZT	P-Fertilizer	50 P_2O_5 drilled with seeds	10 and 11 Nov. 2006
	Seeding Babagha BW	120 kg/ha with Amazone ZT	
CT/ZT	BL Herbicide	EP Granstar	1 Feb 2007

CT/ZT	N top-dressing	40 N as Urea	14 Feb 2007
CT/ZT	Harvesting	Hege	17 June 2007

For wheat, grain yield measured from sub-samples or from machine harvesting of the whole plots were higher under ZT than CC, although these differences were not significant.



Yield (sampling) NS LSD 5% = 0.51; Yield (total field) NS LSD 5% =

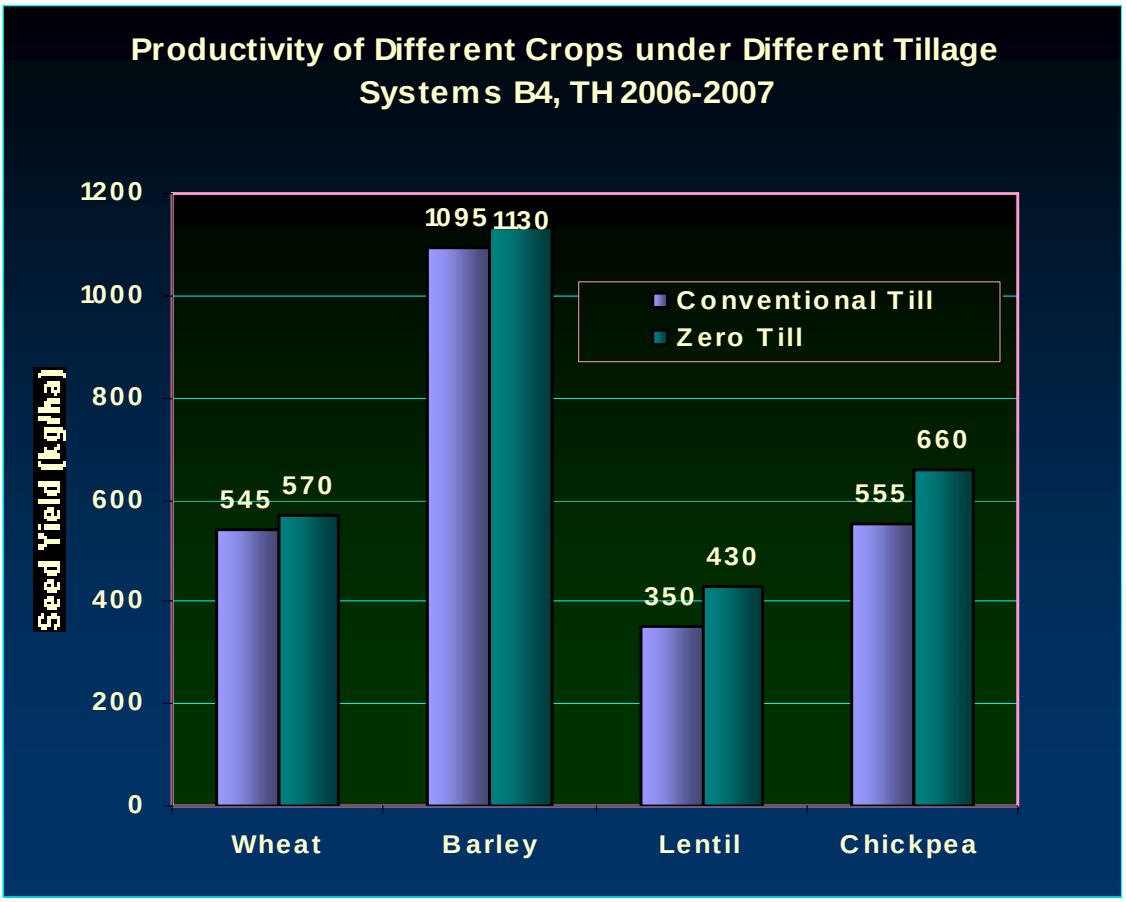
5.1.2.3 Experiment 4 Zero-till bread wheat, durum wheat, chickpea, lentil rotations (on chickpea stubble in 2006-07) (Field B4)

Treatments: Establishment - Zero-till or Conventional tillage
Crops – wheat, chickpea, barley, lentil (in rotation)
Plot size: 24 x 75m
Replicates: 4
Design: Randomized split plot with tillage establishment as main plots and crops as sub-plots (2/4 x 4)

Land preparation and crop management

Treat	Operation	Implement	Date			
			Barley	Wheat	Lentil	Chickpea
CT	Cultivation	Amazone cultivator	11 Nov		24 Nov	

ZT	Herbicide	Glyphosate	9 Nov		25 Nov	
CT/ZT	P fertilizer	40 P_2O_5	11 Nov	13 Nov	25 Nov	26 Nov
CT/ZT	N fertilizer	30 N as Urea	9 Nov			
CT/ZT	Seeding	Indian ZT	11 Nov	13 Nov	25 Nov	26 Nov
CT/ZT	Rolling	12 m roller	13 Nov		26 Nov	
CT/ZT	N fertilizer	40 N as Urea	13 Feb			
CT/ZT	Harvesting	Hege/ Hand for lentil	24 May	30 May	10 May	26 June



LSDs: wheat NS (LSD 5%=161); barley NS (LSD 5%=266); lentil NS (LSD 5%=180); chickpea NS (LSD 5%=220)

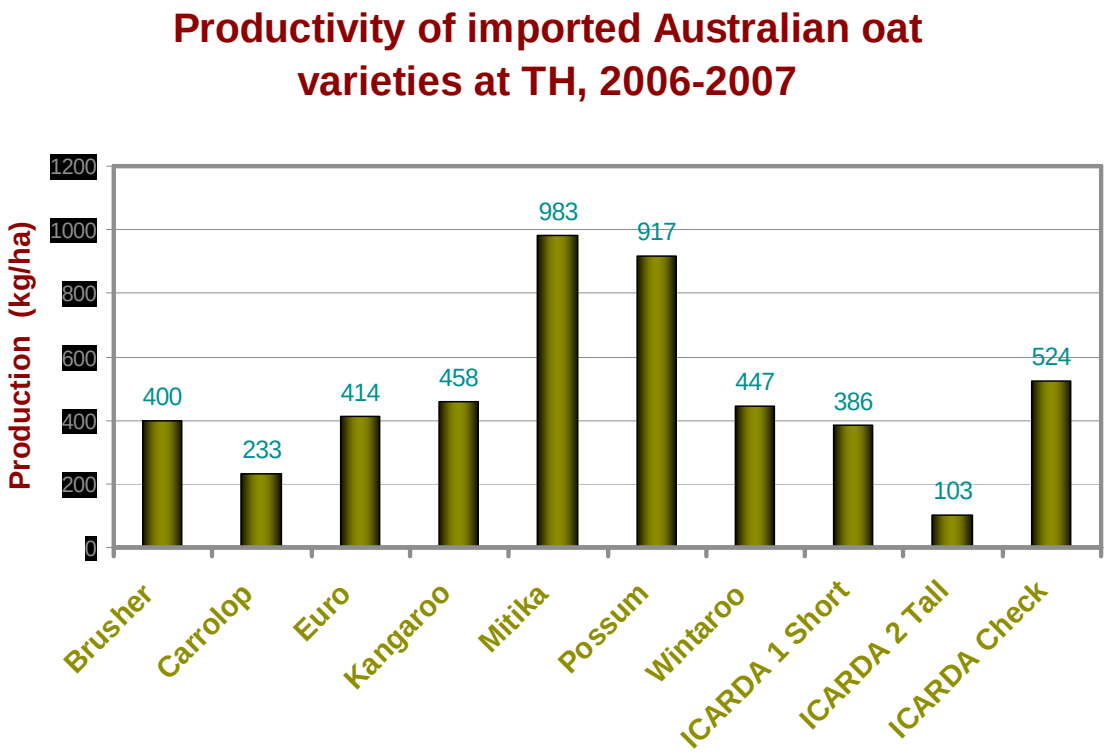
5.1.3 Alternative crops

Objective: To evaluate alternative cereal, legume and oilseed crops for increasing diversity of cropping systems in Mediterranean environments

Three experiments were undertaken on adaptation of lines of oats, oilseeds and peas from Australia (Field B7). However, all established and grew very poorly.

The only adaptation information collected in the 2006-07 cropping season was from oats grown for seed multiplication. Mitiaka and Possum grew well and yielded about 1t/ha. Other varieties yielded ≤ 500kg/ha. This provides some optimism that oats can be developed as a valuable and marketable rotation crop in the region.

Adaptation studies will continue with oats, oilseeds and alternative legumes in 2006-07.



5.1.4 Conclusions

Zero-till and stubble mulching

- showing great potential in the first year of implementation
  - ZT always similar or higher yield than CT
  - benefits likely to increase with time
- need further research, verification and promotion in Iraq and CWANA
  - e.g., spraying before sowing, ZT seeder development, time of sowing, pest/disease management, fertiliser requirements, integration with livestock

Alternative crops (oats, brassicas, peas)

- great potential for diversifying rotations
- inconsistent performance
- need further research

5.1.5 References

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6. Collaborators

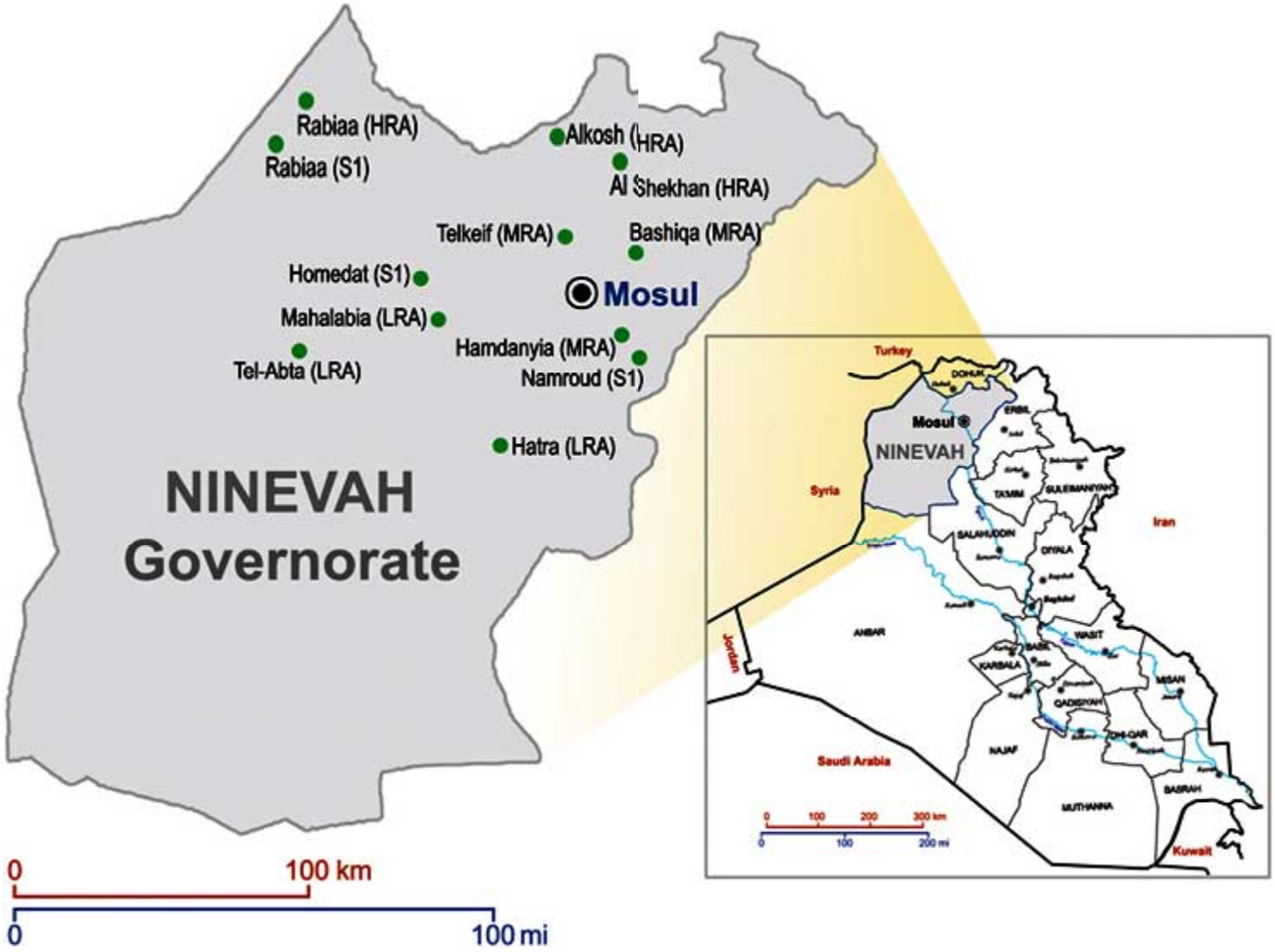
Name/Title	Institution	Address	Fax/Tel	E-mail
Australia				
Dr. Walter Anderson Principal Research Officer	Dept. of Agriculture and Food Western Australia (DAFWA)	444 Albany Highway, Albany, Western Australia 6330	Off: 0061 8 98928417 Fax. 0061 8 98412707 Res: 0061 8 98532225	wanderson@agric.wa.gov.au
Dr Reg Lance Senior Plant Breeder - Barley	Dept. of Agriculture and Food Western Australia (DAFWA)	3 Baron-Hay Court, South Perth, Western Australia 6151	Tel: 61 8 9368 3502 Fax: 618 9474 2840	rlance@agric.wa.gov.au
Professor David Coventry Agronomist	University of Adelaide	Roseworthy Campus, Roseworthy, South Australia 5371	Off: 0061 8 83037954 Res: 0061 8 82322884 Mob: 0061 417874534 Fax: 0061 8 3037730	david.coventry@adelaide.edu.au
Dr. Jens Berger Ecophysiologist	CSIRO-CLIMA	Center for Life Sciences, CSIRO Plant Industry Wembley, West Australia	Off: 0061 8 93336623 Res: 0061 8 93355826 Fax: 0061 8 9387	Jens.Berger@csiro.au
Professor Kadambote Siddique Agronomist	University of Western Australia	Institute of Agriculture, Crawley WA 6009	Tel: 618 6488 7012 Fax: 618 6488 7354	ksiddique@fnas.uwa.edu.au
Dr. Mark Seymour Senior Research Officer	Dept. of Agriculture and Food Western Australia (DAFWA) (representing CLIMA)	PMB 50 Melijinup Road Esperance Western Australia 6450	Off: 0061 8 90831111 Fax. 0061 8 90831100 Mobile: 0061 428925002 Res: 0061 8 90713132	mseymour@agric.wa.gov.au
Mr. Keith Thomas Alcock Director Crop Research	Dept. of Agriculture and Food Western Australia (DAFWA)	Locked Bag 4 - Bentley Delivery Centre WA 6983	Off: 0061 8 93683300 Fax: 0061 8 93682958 Res: 0061 8 62931112	kalcock@agric.wa.gov.au
Mr Robin Ernest Wilson Principal Wheat Breeder	Dept. of Agriculture and Food Western Australia (DAFWA)	3 Baron-Hay Court South Perth Western Australia 6151	Off: 0061 8 93683522 Res: 0061 8 92934719	rwilson@agric.wa.gov.au
Iraq				
MOA Baghdad/Mosul				
Dr. Saleh M. Bader Director General and Project Coordinator	State Board for Agricultural Research (MOA)	Abu- Graib, Baghdad	Off: 00964-1-5112200 / 1 Res: 00964-1-5542715 Mob: 00964-7901916696	drsmbader@yahoo.com
Mr. Kais Aziz Al-Hamdani Counselor D.G. of Extension Cooperation	Ministry of Agriculture	State Board for Agr. Extension and Cooperation Baghdad	Mob: 00964-7901897975	
Mr. Sa'ad H. Mohamed	State Board of	Socio-economics Dept.,	Mob: 00964-7901314537	saadhmohamed@yahoo.com

Research Head Assistant	Agricultural Research	Abu- Graib, Baghdad		
Mr. Watheq Abdul Kahar Al-Rawi Researcher	State Board of Agriculture Research	Socio-economics Dept., Baghdad, Iraq	Mob:00964-790891398	Wathiq60@yahoo.com
Mr. Kefah Tawfiq Saleh Agronomist	State Board of Agriculture Research	Baghdad, Iraq		
Mr. Abdulnasir A. Mohamed Director of Auditing Dept.	Ministry of Agriculture	Baghdad, Iraq		
Mr. Younis H. Qassim Seed Production	Ministry of Agriculture Ninevah	Rashidia Experiment Station, Mosul	Off: 00964-830352	
Dr. Adnan Adary Director	State Board of Agricultural Research/ Ninevah	Rasheedya Experiment Station, Mosul	Off: 00964-60-830352 Mob: 00964-7701667213 Res: 00964-60-510975	adnan_adary@yahoo.com
Dr. Kasim Khalil Kasim Director of Research	State Board for Agriculture Research Ninevah	Rashidia Experiment Station, Mosul	Off: 00964-830352 Res: 00964-77020855549	agrimosul@yahoo.com
DOA Mosul				
Dr. Abdulsattar Asmir Al-Rajbu Director, Project Manager, Agronomist	Directorate of Agriculture, Ninevah	Director and Project Manager	Mob: 00964-7701607473	agrimosul@yahoo.com
Mr. Jaafar S. Saied Deputy Director	Directorate of Agriculture, Ninevah	Deputy Director	Off: 00964 -811958 Mob: 00964-7701646934	agronosul@yahoo.com
Mr. Salim S. Esmael Agricultural engineer	Directorate of Agriculture, Ninevah	Manager of Al Mahalabia Agricultural Section	Off: 060260253 Res: 060512211 Mob: 07701646940	
Mr. Emad Shakir Hermiz Head, Tel Kief	Directorate of Agriculture, Ninevah	Manager of Tel Kief Agricultural Section	Off: 00964-392012 Res: 00964-393015 Mob: 00964-77017192622	agrimosul@yahoo.com
Mr. Haji Mohammad Yakub Agriculture Extension	Directorate of Agriculture, Ninevah	Manager of Al Shykhan Agricultural Section	Off: 00964-7701719265 Mob: 0750469075	
Mr. Zuhair Salem Abou Agricultural Engineer	Directorate of Agriculture, Ninevah	Manager of Bashyqa Agricultural Section	Mob: 00964-77-17-9264	agrimosul@yahoo.com
Mr. Abdul AlMoniem M. Mahmoud Follow up/Third Sector	Directorate of Agriculture, Ninevah	Responsible for the third sector (HRA) and supplementary irrigation (SI)	Mob: 00964-7701646935	abdalmonem@yahoo.com
Mr. Hazem Aziz Saleh Follow up/Second sector	Directorate of Agriculture, Ninevah	Responsible for the second sector (MRA)	Mob: 00964-7709274	

Mr. Bassam Yahya Kassim Follow up/First sector	Directorate of Agriculture, Ninevah	Responsible for the first sector (LRA)	Off: 00964-60816782 Res: 00964-60817800 Mob: 00964-770172481	Bassam819@yahoo.com
Mr. Taha Ahmed Abd Al Azeez Agricultural Engineer	Directorate of Agriculture, Ninevah	Manager of Al Namroud Agricultural Section	Off: 00964-07701646941	
Mr. Sami Ibrahim Mustafa Agricultural Engineer	Directorate of Agriculture, Ninevah	Manager of Al Qush Agricultural Section	Off: 00964-641377 Res: 00964-060514137 Mob: 00964-07701719261	
Mr. Mohamed Sadeq Hassan	Directorate of Agriculture, Ninevah	Manager of Rabiaa Agricultural Section	Off: 00964-06816781 Res: 00964-0672006	agrimosul@yahoo.com
Mr. Manhal Mati Yousif Head of Dept. of Planning	Directorate of Agriculture, Ninevah	Dept of Planning, Mosul	Mob: 00964-7701724893	agrimosul@yahoo.com
Mr. Sabah Abd El-Ahad	Directorate of Agriculture, Ninevah	Manager of Al Hamdania Agricultural Section	Mob: 00964-7701719276 Res: 00964-060382896	
Mr. Amir Hamdoun Shahab Agricultural Engineer	Directorate of Agriculture, Ninevah	Manager of Tell Abta Agricultural Section	Mob: 00964-771646437	
Mr. Azem Mohamed Yahya Head of Dept of Protection	Directorate of Agriculture, Ninevah	Dept of Protection, Mosul	Mob: 00964-7701724895	
Mr. Haydar Nasser Al-Sammak	Directorate of Agriculture, Ninevah	Computer Dept., Al-Faisalieh Street, Mosul	Mob: 00964-06817681 Res: 00964-7701800929	haydernasser@yahoo.com
Mr. Mohana Fathel Al Tak Director of Laboratory	Directorate of Agriculture, Ninevah	Analytical Laboratory, Mosul	Off: 00964-817681 Res: 00964-711308	
Mr. Kofayl Burhan Al Ummary	Directorate of Agriculture, Ninevah	Manager of Al Hatra Agricultural Section	Off: 00964-06816781 Res: 00964-7701646946	agrimosul@yahoo.com
Mr. Thenoun M. Younis Auditor	Directorate of Agriculture, Ninevah	Auditing Department		
University of Mosul				
Prof. Dr. Salem Younis Sultan, Head of Agriculture Economic Dept.	University of Mosul	College of Agriculture & Forestry		
Dr. Emad Yousif Ismael Abdullah, Assistant Professor, Economics	University of Mosul	College of Agriculture & Forestry	Off: 00964-60-510916 Mob:00964-7701684744	
Dr. Suaad Irdeny Abdullah Professor, Entomology	University of Mosul	College of Agriculture & Forestry	Mob: 00964-7701631609	Suaad53irdeny@yahoo.com
ICARDA				
Dr M. Solh Dr A. El-Ahmed	Dr M. Abang Dr S. Grando	Dr S. Kumari Dr A. Yahyaoui	Off: 963 21 221 3433	name@cgiar.org

Dr A. Sidahmed Dr Z. Abdul-Hadi Dr M. Pala Dr. J. Diekman Dr N. Haddad Dr C. Piggin Mr Abdoul Aziz Niane	Dr A. Sarker Dr R. Malhotra Dr S. Ceccarelli Dr O. Abdullah Dr M. Nachit Dr K. Shideed Dr M. Bohssini	Dr Z. Bishaw Dr K. Amegbeto Dr B. Bayaa Dr Siham Asaad Dr A. Amri Dr E. Bailey Mr A. Haddad		

Appendix 1 Location of demonstration sites in Ninevah, Iraq



Appendix 2 Details of demonstration sites and crop management 2006-07

Table A
Rain Zone: LRA
Location: Al Mahalabia Area: 1 ha. For each cultivar Soil texture: sandy loam
Farmer Name: Adeel M. Khther Village: Almahalabia Total annual rain fall: 273mm

Crop name	Variety	Planting methods	Date of Ploughing	Amount of seed kg/donum	Date of sowing	Seeder type	Fertilizer kg/donum	Weed control
Barley	Zanbaka Local black barely	Chisel	25/11/2006	30	29/11/2006	Kaspardo	-	-
		Zero tillage		30	28/11/2006	Zero tillage	-	1 l/donum Gramoxone before sowing
		Farmers method	25/11/2006	30	30/11/2006	Seed disk	-	-

Table B
Rain Zone: LRA
Location: Al Hatra Area:1 ha. for each cultivar Soil texture : Sandy clay loam
Farmer Name: Ahmed Attea Tallaal Village : Aghlyba Total annual rain fall: 127mm

Crop name	Variety	Planting methods	Date of Ploughing	Amount of seed kg/ donum	Date of sowing	Seeder type	Fertilizer kg/ Donum	Weed control
Barley	Zanbaka	Zero tillage		30	5/12/2006	Zero tillage		1 l/donum Gramoxone before sowing
	Local black barley	Farmers method	6/12/2006	30	6/12/2006	Seed disk	-	-

Table C
Rain Zone : LRA
Location: Tell Abta | Area:1 ha. For each cultivar | Soil texture: Clay Loam
Farmer Nam : Nawaf Hamid Matlek | Village : Youstaba | Total annual rain fall: 187 mm

Crop name	Variety	Planting methods	Date of Ploughing	Amount of seed kg/ Donum	Date of sowing	Seeder type	Fertilizer kg/ Donum	Weed control
Barley	Zanbaka	Chisel	5/12/2006	30	11/12/2006	Zero tillage	-	-
	Local black	Zero tillage		30	11/12/2006	Zero tillage	-	Protection of weed before sowing by Gramaxion in amount of 1lit.\Donum
		Farmers method	5/12/2006	30	12/12/2006	Seed disk	-	-

Table D
Rain Zone: MRA
Location: Al Hamdania Area :1 ha. For each cultivar Soil texture : loam
Farmer Name: Abas Saber Ali Village: Twajna Total nnual rain fall 386mm

Crop name	Variety	Planting methods	Date of ploughing	Seed rate kg/donum	Date of sowing	Seeder type	Weed Control	Fertilizer kg/donum
Durum Wheat	OM Rabia/5	Chisel	10/12/2006	35 Kg	17/1/2007	Seed disk	Protection from wide and narrow weeds during the third month by Chevalier	16 Dap + 20Urea with sowing& 20 Urea second addition.
		Z.T		35 Kg	16/1/2007	Z.T	Gramaxion before sowing and Chevalier during the third month	16 Dap + 20Urea with sowing& 20 Urea second Addition.
	Karonia	Farmer Method	1/12/2006	50 Kg	17/1/2007	Seed disk	Chevalier during the third month	30 NPK 18:18:0
Barley	Rihan /3	Chisel	10/12/2006	30 Kg	17/1/2007	Seed disk	-	-
	Jazzera /1	Z.T		30 Kg	16/1/2007	Z.T	-	Gramoxone before sowing
		Farmer Method	2/12/2006	50 Kg	17/1/2007	Seed disk	-	-

Table E
Rain Zone: MRA
Location: Telkief Area: 1 ha. For each cultivar Soil texture: Clay Loam
Farmer name: Mohamed Ali Najim Village: Tell Yabis Total annual rain fall 337mm.

Crop name	Variety	Planting methods	Date of ploughing	Seed rate kg/donum	Date of sowing	Seeder type	Weed Control	Fertilizer kg/donum
Durum Wheat	Om Rabia/5	Chisel	14/11/2006	35 Kg	19/1/2007	Kaspardo	Chevalier during the third month	16 Dap + 20Urea with sowing& 20 Urea second addition.
		Z.T		35 Kg	21/1/2007	Z.T	Gramaxion before sowing and Chevalier in third month	16 Dap + 20Urea with sowing& 20 Urea second addition.
	Karonia	Farmer Method	26/11/2006	35 Kg	21/1/2007	Seed disk		15 Dap+20 Urea
Bread wheat	Cham/6	Chisel	14/11/2006	30 Kg	20/1/2007	Kaspardo	Chevalier during the third month	16 Dap + 20Urea with sowing& 20 Urea second addition.
	Abo Ghraib/3	Z.T		30 Kg	21/1/2007	Z.T	Gramaxion before sowing and Chevalier in third month	16 Dap + 20Urea with sowing& 20 Urea second addition.
	Tell Affer/3	Farmer Method	26/11/2006	30 Kg	21/1/2007	Seed disk	-	15 Dap + 20Urea
barley	Rihan/3	Chisel	14/11/2006	30 Kg	19/1/2007	Seed disk		
	Jazzera/1	Z.T		30 Kg	21/1/2007	Z.T	-	Gramoxone at sowing
		Farmer Method	26/11/2006	30 Kg	19/1/2007	Seed disk	-	-

Table F
Rain Zone: MRA
Location: Bashyqa Are : 1 ha. For each cultivar Soil texture : Sandy Loam
Farmer Name: Salo hamuka Jamaa Village: Achichokh Total annual rain fall 193mm

Crop name	Variety	Planting method	Date of plouhging	Seed rate kg/donum	Date of sowing	Seeder type	Weed Control	Fertilizer kg/donum
Durum Wheat	OM Rabia/5 Karonia Cham /5	Chisel	25/11/2006	35 Kg	18/1/2007	Seed disk	Lantor & Topic during the third month	16 Dap + 20Urea with sowing& 20 Urea second addition
		Z.T		35 Kg	18/1/2007	Z.T	Gramaxion was used before sowing and Chevalier during the third month	16 Dap + 20Urea with sowing& 20 Urea second addition
		Farmer Method	25/11/2006	35 Kg	18/1/2007	Seed disk	-	20 NPK 18:18:0
Bread wheat	Cham/6 Abo Ghraib /3	Chisel	25/11/2006	30 Kg	18/1/2007	Chisel	Lantor & Topic during the third month	16 Dap + 20Urea with sowing& 20 Urea second addition
		Z.T		30 Kg	18/1/2007	Z.T	Gramaxion was used before sowing and Chevalier during the third month	Gramoxone before planting & Lantor &Topic in month 3
		Farmer Method	25/11/2006	30 Kg	18/1/2007	Seed disk	-	20 NPK 18:18:0
Barley	Rihan /3 Jazzera /1	Chisel	26/11/2006	30 Kg	19/1/2007	Seed disk	-	-
		Z.T		30 Kg	19/1/2007	Z.T	-	Gramoxone before sowing
		Farmer Method	26/11/2006	30 Kg	19/1/2007	Seed disk	-	-

Table G

Rain Zone :HRA
Location: Al-Qush Area :1 ha. for each cultivar Soil texture : loam
Farmer Name: Bashar Yousif Polus Village: Al Qush Total annual rainfall 369.5mm + 8 cm ice)

Crop name	Variety	Planting methods	Date of ploughging	Seed rate kg/donum	Date of sowing	Seeder type	Fertilizer kg/donum	Weed Control
Durum Wheat	Cham\3	Chisel	26/11/2006	35 Kg	15/1/2007	Kaspardo	18 Dap + 20Urea with sowing& 20 Urea second addition.	Chevalier during the third month
	Karonia	Z.T		35 Kg	24/1/2007	Z.T	18 Dap + 20Urea with sowing& 20 Urea second addition.	Gramaxion before sowing & Chevalier during the third month
		Farmer Method	26/11/2006	35 Kg	15/1/2007	Hoe	15 Dap + 20 Urea	-
Bread Wheat	Abo Ghrab\3	Chisel	26/11/2006	30 Kg	15/1/2007	Kaspardo	18 Dap + 20Urea with sowing& 20 Urea second Addition.	Chevalier during the third month
	Cham\4	Z.T		30 Kg	24/1/2007	Z.T	18 Dap + 20Urea with sowing& 20 Urea second Addition.	Gramaxion before sowing & Chevalier during the third month
	Cham\6	Farmer Method	26/11/2006	30 Kg	15/1/2007	Hoe	15 Dap + 20urea	-

Table H
Rain Zone: HRA
Location: Rabia Area :1 ha. for each cultivar Soil texture: Clay loam
Farmer Name: Abd al Hamid M. Hassen Village: Al Qahara Total annual rainfall 240 mm

Crop name	Variety	Planting methods	Date of ploughing	Seed rate kg/donum	Date of sowing	Seeder type	Fertilizer kg/donum	Weed Control
Durum wheat	Cham/3	Chisel	12/12/2006	35Kg	26/1/2007	Kaspardo	18 Dap + 20Urea with sowing& 20 Urea second addition.	Chevalier during the third month
		Z.T		35 Kg	26/1/2007	Z.T	18 Dap + 20Urea with sowing& 20 Urea second addition.	Gramaxion before sowing & chevalier during the third month
	Karonia	Farmer Method	12/12/2006	35 Kg	26/1/2007	Seed disk	18 NPK 18:18:0	Chevalier during the third month
Bread wheat	Abo Ghraib/3	Chisel	12/12/2006	30 Kg	26/1/2007	Kaspardo	18 Dap + 20Urea with sowing& 20 Urea second addition.	Chevalier during the third month
		Z.T		30 Kg	26/1/2007	Z.T	18 Dap + 20Urea with sowing& 20 Urea second addition.	Gramaxion before Sowing & Chevalier during the third month
	Cham/6	Farmer Method	12/12/2006	30 Kg	26/1/2007	Seed disk	18 NPK 18:18:0	Chevalier during the third month

Table I

Rain Zone: HRA

Location: Al-Shykhan | Area:1 ha. for each cultivar | Soil texture: Clay loam

Farmer Name: Shaker Ibrahim Jamaa | Village: Al Rashdiya | Total annual rainfall 471mm + 7cm ice

Crop name	Variety	Planting methods	Date of ploughing	Seed rate kg/donum	Date of sowing	Seeder type	Fertilizer kg/donum	Weed Control
Durum Wheat	Cham\3	Chisel	30/11/2006	35 Kg	21/1/2007	Rama	18 DAP + 20Urea with sowing& 20 Urea second addition.	Chevalier in third month
	Karonia	Z.T		35 Kg	22/1/2007	Z.T	18 DAP + 20Urea with sowing& 20 Urea second addition.	Gramaxion before sowing & Chevalier in third month
		Farmer Method	30/11/2006	35 Kg	21/1/2007	Seed disk	18 DAP	
Bread Wheat	Abo Ghrab\3	Chisel	30/11/2006	30 Kg	21/1/2007	Rama	18 DAP + 20Urea with sowing& 20 Urea second addition.	Chevalier during the third month
	Cham\6	Z.T		30 Kg	22/1/2007	Z.T	18 DAP + 20Urea with sowing& 20 Urea second addition.	Gramaxion before sowing & Chevalier in third month
		Farmer Method	30/11/2006	30 Kg	21/1/2007	Seed disk	18 DAP	

Table J
Rain Zone: SI
Location: Al Namroud | Area: 1 ha. for each cultivar | Soil texture: loam
Farmer Name: Sinan Abdulah Aljalili | Village: City center | Total annual rainfall 240mm

Crop name	Variety	Planting methods	Date of Ploughing	Seed rate kg/donum	Date of sowing	Seeder type	Fertilizer kg/donum	Weed control
Durum wheat	Om Rabia Cham / 3	Chisel	3/12/2006	35	4/12/2006	Kaspardo	25 Dap + 30 Urea with sowing	Topic+Lantor fourth month
		Zero tillage		35	4/12/2006	Zero tillage	25 Dap + 30 Urea with sowing	Gramaxion before sowing Topic + Lantor in fourth month
		Farmers method	3/12/2006	35	4/12/2006	Seed disk	25 Dap + 30 Urea with sowing	Topic+Lantor during the forth month

Table K
Rain Zone: SI
Location: Hamidat | Area: 1 ha. for each cultivar | Soil texture :Clay
Farmer Nam : Mahmoumd Abd Allh Ali | Village: Masayed | Total annual rain fall 337mm

Crop name	Variety	Planting methods	Date of Ploughging	Seed rate kg/donum	Date of sowing	Seeder type	Fertilizer kg/donum	Weed control
Durum wheat	Om Rabia Cham/3	Chisel	5/12/2006	35	21/12/2006	Rama	25 Dap + 20Urea with sowing& 20 Urea second addition.	Grass and BL herbicides during the third month
		Zero tillage		35	17/12/2006	Zero tillage	25 Dap + 20Urea with sowing& 20 Urea second addition.	Gramaxion before sowing 1l/dounm & grass and BL herbicides during the third month
		Farmers method	3/12/2006	35	21/12/2006	Seed disk	25 Dap + 20Urea with sowing& 20 Urea second addition.	Grass and BL herbicides during the third month
Bread wheat	Adnania Tell affer/3	Chisel	5/12/2006	30	21/12/2006	Rama	25 Dap + 20Urea with sowing& 20 Urea second addition.	Grass and BL herbicides during the third month
		Zero tillage		30	17/12/2006	Zero tillage	25 Dap + 20Urea with sowing& 20 Urea second addition.	Grass and BL herbicides during the third month
		Farmers method	5/12/2006	30	21/12/2006	Seed disk	25 Dap + 20Urea with sowing & 20 Urea second addition.	Grass and BL herbicides during the third month

Table L
Rain Zone: SI
Location: Rabiaa | Area: 1 hec. for each cultivar | Soil texture : Clay Loam
Farmer Name: Swoad Sarigh | Village: Tell Asmyer | Total annual rain fall 232mm

Crop name	Variety	Planting methods	Date of ploughging	Seed rate kg/donum	Date of sowing	Seeder type	Fertilizer kg/donum	Weed Control
Durum wheat	Cham/3 Om Rabia/5	Chisel	2/12/2006	35 Kg	23/1/2007	Kaspardo	25kkg dap with planting 20 kg urea first amount 20 kg urea second amount	Chevaliar during third month
		Z.T		35 Kg	23/1/2007	Z.T	25kkg dap with planting 20 kg urea first amount 20 kg urea second amount	Gramoxone before planting Chevaliar during third month
		Farmer Method	12/12/2006	35 Kg	23/1/2007	Seed disk	-	-
Bread wheat	Tell affer /3 Adnania	Chisel	2/12/2006	30 Kg	23/1/2007	Kaspardo	25kkg dap with planting 20 kg urea first amount 20 kg urea second amount	Chevaliar during the third month
		Z.T	-	30K.g	23/1/2007	Z.T	25kkg dap with planting 20 kg urea first amount 20 kg urea second amount	Gramoxone before planting Chevaliar during third month
		Farmer Method	12/12/2006	30K.g	23/1/2007	Seed Disk	-	-

Appendix 3 Demonstration sites rainfall 2006-07

High rainfall areas - daily and total rain fall for 2006/2007 (mm)																																
Location	**Month/day**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**Total**
Shykan	**Oct 06**																										18		8	25	12		63
	Nov	18	15				7									8	1				18												67
	Dec																											24 +3cm ice	73				97 +3cm ice
	Jan 07						63 + 4cm ice																							10		6	79 + 4cm ice
	Feb				50	5	13										8	17	10														103
	Mar						18																										18
	Apr		18	8																													26
	May														18																		18
	Total																															471 + 7cm ice	
Alqush	**Oct 06**																											6	10	11		4,5	31,5
	Nov	12														4,5					22,5												39
	Dec																											21	44	1			66
	Jan 07						25 + 8cm ice																							6		10,5	41.5 + 8cm ice
	Feb				27	8	9	12	4					1			20		13								1						95
	Mar						11,5								4,5		5	2	1,5		4,5				2,5								31,5
	Apr		5,5	5				4					5			10	9			2,5									4			45
	May													1,5	13		5,5																20
	Total																															369.5 + 8cm ice	
Rabiaa	**Oct 06**																									40			8	16			64
	Nov															5																	5
	Dec																											9	11				20
	Jan 07					8																										8	16
	Feb				8	4	5	1						3			8		14	5													48
	Mar					4	13									4			1		3	12			4								43
	Apr		11		7						4		6			2	2								4						2		38
	May																																0
	Total																																232

Medium rainfall areas - daily and total rain fall for 2006/2007 (mm)																																
Location	**Month / day**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**Total**
Tellkief	**Oct-06**																								3	6,5		6	15,5	1	11		43
	Nov	20					5,5									1	3			10,5													40
	Dec																											8,5	42	2,5			53
	Jan-07					22,5			1				1																3,5	1,5		3	32,5
	Feb				31	9	3,5	4,5									13,5	6									1						68,5
	Mar					9										10	5	5		2					3								34
	April	2		6	3,5			8				4	8,5		1	2				4			0,5					1	3				43,5
	May													8	14,5																		22,5
	Total																																337
Hamdania	**Oct-06**																													45	18		63
	Nov	14																	9														23
	Dec																												30				30
	Jan-07							26																						6		5	37
	Feb				60	4	10	4	26								20		14								4						142
	Mar					5												25			4				6								40
	April		6	8	6			2		7				7		10														5			51
	May																																0
	Total																																386
Bashyqa	**Oct-06**																											8	11				19
	Nov		10													5																	15
	Dec																											4	30				34
	Jan-07					20																								3		3	26
	Feb				20	2	5	2	15																								44
	Mar					5										6	5	5			2												23
	April	3	15					3					4			2					3									2			37
	May																																0
	Total																																193

Low rainfall areas - daily and total rain fall for 2006/2007 (mm)																																
Location	**Month / days**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**Total**
Hatra	**Oct-06**																										15	18					33
	Nov																																0
	Dec																											11					11
	Jan-07					4		12					4.5																2			1	23.5
	Feb				22	2								5			6															35
	Mar					2										2	2.5							2.5								9
	April	3	3,5												5	2												2				15.5
	May																7															7
	Total																															127
Tel Abta	**Oct-06**																								20		12	6				38
	Nov		27																													27
	Dec																											17				17
	Jan-07						7	6	4				1																1		3	22
	Feb				23	3	3		12				3			9	6										2					61
	Mar					4										1			4		1				3							13
	April	2		3				4																								9
	May						9																									0
	Total																															187
Al-Mahlveaa	**Oct-06**																									80			20	2			102
	Nov	3																														3
	Dec																											8	22				30
	Jan-07					12		6	1				2																	4		4	29
	Feb				30	11		2						2			8	7	3								3					66
	Mar					5										5		2							2							14
	April	4	7	2				4					2		2	2	2				4											29
	May														10	53																63
	Total																															273

Supplementary irrigation areas - daily and total rain fall for 2006/2007 (mm)																																
Location	**Month/days**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**Total**
Hamidat	**Oct-06**																												10	20	5		35
	Nov	5	7					7												3	30												52
	Dec																											18	22				40
	Jan-07					20			5						2															4		2	33
	Feb				28	10		7									5	8	14								3						75
	Mar						7									7		14							7								35
	April		7	6	1			7							6	2												2				31
	May														5	26	5															36
	Total																															337
ALNamroud	**Oct-06**																													42	18		60
	Nov																3																3
	Dec																													15			15
	Jan-07							19		9					3															4		3	38
	Feb				45	2	4												9									2					62
	March					1												8			2				5							16
	April	4		12						3	2		6			6	1						2							4			40
	May															6																	6
	Total																																240
Rabiaa	**Oct-06**																									40			8	16			64
	Nov															5																	5
	Dec																											9	11				20
	Jan-07					8																										8	16
	Feb				8	4	5	1						3			8		14	5													48
	Mar					4	13									4			1		3	12			4								43
	April		11		7						4		6			2	2								4					2		38
	May																																0
	Total																																232