



# Long-term Cereal/Forage legume Rotation Trials

## Progress Report

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## Introduction

ICARDA has over the years carried out research on dual purpose cereals for ruminants focussing on breeding material (barley and bread wheat elite lines) with dual purpose traits. Most of the dual-purpose trials were conducted under a cutting regime. Current research is now focussing on dual purpose cereals under sheep grazing because that is the normal farmer's practise in the WANA region. Selection of dual-purpose varieties for sheep grazing is particularly important in Morocco to close the forage gap in winter season and spring-time.

Cereals stubble grazing after harvest is a common practice in Morocco, especially in the highlands where small ruminants are reared under extensive grazing systems. In these systems, crops are cultivated under rainfed conditions. ICARDA's activities on forage production in Morocco will, therefore, focus on rainfed conditions with barley and triticale in mixtures with forage legumes.

## Methodology

Trials were conducted on Marchouch station, GPS coordinates 3333038.200N 641024.700W, which is located 60 km South of the capital city of Rabat). Fig 1. Shows the temperatures and precipitation inn Marchouch station during the trial period of August 2018 to February 2019. This temperature range of 9C - 25C is typical in Marchouch during this time of the year. Precipitation was low, with a total of 58.6mm between December 2018 and February 2019.

Forage varieties of cerals included barley, triticale and oat. The forage legumes included vetch, forage pea and sulla and grasspea. These were sown in pure seeds and in mixtures. Also included in the trials were seeded varieties of annual rye grass, Italian rye grass, tall fescue and forage rye.



**Fig. 1 Meteorological data Marchouch station August 2018 – February 2019**

## Trials

A total of 10 trials were undertaken as follows :

- Mixtures of triticale and barley with different forage legumes
- Dual Purpose Barley
- Dual Purpose Bread Wheat
- Screening barley varieties in pure seeds and mixtures with vetch /grasspea
- Screening barley varieties in pure seeds and mixtures with different forage pea varieties
- Screening forage rye and triticale varieties in pure seeds and mixtures with vetch
- Screening different forage grasses in pure seeds and mixtures with vetch
- Screening vetch and grasspea varieties in pure seeds and mixtures with barley
- Screening different forage grasses in pure seeds and mixtures with vetch
- Screening oat varieties in pure seeds and mixtures with vetch
- Dual Purpose Barley and Bread Wheat under sheep grazing

### Mixtures of triticale and barley with different forage legumes

*Specific objective :*

To determine effects of triticale and barley with 4 forage legumes (vetch, grasspea, forage pea, sulla) in pure seeds and mixtures on DM yield and forage quality.

*Crops:*

A total of 17 mixtures and varieties.

Juanillo (triticale); Lannaceur (barley) ; Yamama (vetch); ICARDA 147655 (grasspea ; Navarro, 'candidate' (forage pea) ; Wilpena (sulla). E

*Experimental design:*

A randomized complete block design with 3 replicates. Plot size was 1.4 m x 7.5 m. Seeding rate was pure seeds of cereals at 120 g/plot and forage legumes at 200 g/plot. Mixtures had 60 % cereals and 40 % forage legumes from pure seed rate. Fertilization was 45 kg P2O5/ha, 45 kg K2O/ha, 15 kg N/ha pure forage legumes, 35 kg N/ha mixtures cereals/forage legumes, 90 kg N/ha pure cereals The seeding date was 08. Dec 2018

*Preliminary results:*

Seeding date was late, however, the germination and field emergence was good due to 25 mm precipitation received. There are differences between the replications. The first replication has more gaps than the second and third replication. The trial can be used for statistical analysis.

### Dual Purpose Barley

*Specific Objective:*

To test 4 barley varieties (from the Moroccan seed catalogue) and 6 ICARDA lines for dual purpose utilization with 2 different cutting times at tillering and stem elongation.

*Crops:*

Four varieties: Amalou, Amira, Laanaceur, Oussama



ICARDA candidate lines: CompCr229//As46/Pro/3/Srs/4/RWA-M47/5/Carbo/Hamra/4/Rhn-08/3/DeirAlla106//DL71/Strain205 ; Rhn//Bc/Coho/3/DeirAlla106//Api/EB89-8-2-15-4/5/CM67/3/Apro//Sv02109/Mari/4/Carbo/6/Lignee527/NK1272//JLB70-063/3/Rhn-03 ; Lignee527/NK1272//JLB70-063/3/Alanda/Zafraa//Gloria'S'/Copal'S'/4/Gloria'S'/Copal'S'//As46/Aths/3/Rhn-03 ; Sara/4/H.Spont.96-3/3/Roho//Alger/Ceres362-1-1/5/ROBUR-BAR/J126//OWB753431D/SL3/4/GLORIA-BAR/COPAL//BEN.4D/3/SP-B ; Rhn//Bc/Coho/3/DeirAlla106//Api/EB89-8-2-15-4/5/CM67/3/Apro//Sv02109/Mari/4/Carbo/6/Momtaz ; Lignee527/NK1272//JLB70-063/3/Bda/4/Momtaz

*Experimental design:*

There were 3 treatments; control, 1<sup>st</sup> cutting, 2<sup>nd</sup> cutting. Plot size was 1.4 m x 2.5 m. Seeding rate was 35 g/plot. Fertilisation of 45 kg P<sub>2</sub>O<sub>5</sub>/ha, 45 kg K<sub>2</sub>O/ha, 140 kg N/ha (65+75). Seeding date was 17 Dec 2018.

*Preliminary results:*

The seeding date was late. This resulted in delayed germination and poor and uneven crop emergence. The data cannot be used for a statistical analysis.

## Dual Purpose Bread Wheat

*Specific objective:*

To test 4 bread wheat varieties (from the official catalogue) and 6 ICARDA elite lines for dual purpose utilization with 2 different cutting times at tillering and stem elongation.

*Crops:*

Four varieties of bread wheat: Achtar, Aguila, Arrehane, Najia

Six candidate lines: SERI.1B//KAUZ/HEVO/3/AMAD/4/FLAG-2 ; ATILA\*2/RAYON//CATBIRD-1 ; CHAM-4/MUBASHIR-9 ; Tesfa ; SERI.1B//KAUZ/HEVO/3/AMAD/4/PFAU/MILAN ; DAJAJ-5/4/CHEN/AEGILOPS SQUARROSA (TAUS)//BCN/3/KAUZ

*Experimental design:*

Ten varieties/candidates with 3 treats (control, cutting 1, cutting 2). Plot size was 1.4 m x 2.5 m. Seeding rate of 35 g/plot and fertilization of 45 kg P<sub>2</sub>O<sub>5</sub>/ha, 45 kg K<sub>2</sub>O/ha, 140 kg N/ha (65+75). Seeding date was 17 Dec 2018.

*Preliminary results:*

The seeding date was late and resulted in delayed germination and a poor and uneven crop emergence. The data cannot be used for statistical analysis.

### Screening barley varieties in pure seeds and mixtures with vetch / grasspea

#### *Specific objective:*

To test 5 barley varieties (from the official seed catalogue) in pure seeds and mixtures with a vetch variety and a grasspea variety.

#### *Crops:*

Varieties: Amalou, Amira, Laanaceur, Oussama, Ksiba (barley), Yamama (vetch) and Jabouleh (grasspea)

#### *Experimental design:*

17 mixtures/varieties in a randomized complete block design with 3 replicates. Plot size was 1.4 m x 7.5 m. Seeding rate: Pure seeds barley 120 g/plot, vetch/grasspea 90 g/plot ; Mixtures: barley 80 g/plot + 40 g/plot vetch/grasspea. Fertilization was 45 kg P<sub>2</sub>O<sub>5</sub>/ha, 45 kg K<sub>2</sub>O/ha, 15 kg N/ha pure forage legumes, 35 kg N/ha mixtures cereals/forage legumes, 90 kg N/ha barley pure. Seeding date: 18 Dec 2018

#### *Preliminary results:*

The seeding date was too late and resulted in delayed germination and a poor and uneven crop emergence. The data cannot be used for a statistical analysis.

### Screening barley varieties in pure seeds and mixtures with different forage pea varieties

#### *Specific objective:*

To test 3 barley varieties (from the official seed catalogue) in pure seeds and mixtures with 4 forage pea varieties (2 inscribed varieties and 2 candidates).

#### *Crops:*

Varieties: Amalou, Amira, Ksiba (barley), Navarro, 'candidate', Jawhara, Azzahra (forage pea)

#### *Experimental design:*

Seventeen mixtures/varieties in a randomized complete block design with 3 replicates. Plot size was 1.4 m x 7.5 m. Seeding rate: pure seeds barley 120 g/plot, forage pea 200 g/plot ; Mixtures: barley 60 g/plot + 100 g/plot forage pea. Fertilization was 45 kg P<sub>2</sub>O<sub>5</sub>/ha, 45 kg K<sub>2</sub>O/ha, 15 kg N/ha pure forage pea, 35 kg N/ha mixtures cereals/forage legumes, 90 kg N/ha barley pure. Seeding date was 18 Dec 2018.

#### *Preliminary results:*

The delayed seeding date delayed germination and resulted in a poor and uneven crop emergence. The data can not be used for a statistical analysis.

### Screening forage rye and triticale varieties in pure seeds and mixtures with vetch

#### *Specific objective:*

To test 2 forage rye varieties (european varieties) and 3 triticale varieties (from the official seed catalogue) in pure seeds and mixtures with a vetch variety (Yamama).

*Crops:*

Varieties: Traktor, Inspekor (forage rye), Juanillo, Drira, Maroua (triticale) and Yamama (vetch).

*Experimental design:*

Ten mixtures/varieties in a randomized complete block design with 3 replicates. Plot size: was 1.4 m x 7.5 m. Seeding rate was forage rye/triticale 120 g/plot, forage pea 200 g/plot ; Mixtures: forage rye/triticale 80 g/plot + 40 g/plot vetch. Fertilization was 45 kg P<sub>2</sub>O<sub>5</sub>/ha, 45 kg K<sub>2</sub>O/ha, 35 kg N/ha mixtures cereals/forage legumes, 90 kg N/ha pure cereals. Seeding date was 18 Dec 2018.

*Preliminary results:*

The late seeding date delayed germination resulting in a poor and uneven crop emergence. The data cannot be used for a statistical analysis.

### **Screening different forage grasses in pure seeds and mixtures with vetch**

*Specific objective:*

To test 2 italian ryegrass varieties, 2 annual ryegrass varieties and 1 tall fescue variety (all european varieties) in pure seeds and mixtures with a vetch variety (Yamama).

*Crops:*

Varieties: Zarastro, Jeanne (italian raigrass), Jivet, Peleton (annual raigrass), Becva (tall fescue), Yamama (vetch).

*Experimental design:*

Ten mixtures/varieties in a randomized complete block design with 3 replicates. Plot size was 1.4 m x 7.5 m. Seeding rate was forage grasses pure 50 g/plot ; Mixtures: forage grass 40 g/plot + 30 g/plot vetch. Fertilization was 45 kg P<sub>2</sub>O<sub>5</sub>/ha, 45 kg K<sub>2</sub>O/ha, 35 kg N/ha mixtures cereals/forage legumes, 90 kg N/ha pure forage grass. Seeding date was 18 Dec 2018.

*Preliminary result:*

The seeding date was late. It delayed germination and resulted in a poor and uneven crop emergence. The data cannot be used for a statistical analysis.

### **Screening oat varieties in pure seeds and mixtures with vetch**

*Specific objective:*

To test 3 oat varieties and 1 triticale variety (from the official seed catalogue) in pure seeds and mixtures with a vetch variety and a mixture with oat/triticale/vetch.

*Crops :*

Varieties: Tissir, Amlal, Soualem (oat), Juanillo (triticale), Yamama (vetch).



*Experimental design:*

10 mixtures/varieties in a randomized complete block design with 3 replicates. Plot size was 1.4 m x 7.5 m. Seeding rate: oat pure 120 g/plot ; Mixtures: oat 40 g/plot + 40 g/plot vetch. Fertilization: 45 kg P<sub>2</sub>O<sub>5</sub>/ha, 45 kg K<sub>2</sub>O/ha, 35 kg N/ha mixtures cereals/forage legumes, 90 kg N/ha pure cereals. Seeding date: 18 Dec 2018.

*Preliminary results:*

The seeding date was too late and resulted in delayed germination and poor and uneven crop emergence. The data cannot be used for a statistical analysis.

### Screening vetch and grass-pea varieties in pure seeds and mixtures with barley

*Specific objective:*

To test 3 vetch varieties and 2 grasspea varieties (from the official seed catalogue) in pure seeds and in a mixtures with a new inscripted barley variety (Ksiba).

*Crops:*

Varieties: Yamama, Guich, Salhouma (vetch), ICARDA 147655, Jabouleh (grasspea), Ksiba (barley).

*Experimental design:*

10 mixtures/varieties in a randomized complete block design with 3 replicates. Plot size was 1.4 m x 7.5 m. Seeding rate: vetch/grasspea pure 100 g/plot ; Mixtures: vetch/grasspea 50 g/plot + 60 g/plot barley (variety Ksiba). Fertilization : 45 kg P<sub>2</sub>O<sub>5</sub>/ha, 45 kg K<sub>2</sub>O/ha, 15 kg N/ha pure forage legumes, 35 kg N/ha mixtures forage legumes/barley. Seeding date was 18. Dec 2018.

*Preliminary result:*

The seeding date was late and resulted in delayed germination and a poor and uneven crop emergence. The data cannot be used for a statistical analysis.

One forage trial was carried out in EL Koudia station (INRA) in December 2018:

### Dual Purpose Barley and Bread Wheat under sheep grazing

*Specific objective:*

To test 4 barley varieties and 4 bread wheat varieties (from the official seed catalogue) under sheep grazing at tillering and stem elongation.

*Crops:*

Varieties: Amalou, Amira, Laanaceur, Oussama (barley), Achtar, Arrehane, Kenz, Faiza (bread wheat).

*Experimental design:*

Treatments: 8 varieties (4 barley, 4 bread wheat) with 3 treats (control, grazing 1, grazing 2) in a strip alley design without real replicates (3 replicates each strip alley). Plot size was 18 m x 80

m. Seeding rate was 100 kg/ha. Fertilization was 45 kg  $P_2O_5$ /ha, 45 kg  $K_2O$ /ha, 125 kg N/ha (50+75). Seeding date was on 13 - 18 Dec 2018.

Grazing with sheep breed INRA 180 at tillering stage/stage of stem elongation with a stocking rate of 125 heads/ha.

*Preliminary result:*

Due to high rainfall on 13. December only 3 wheat varieties were seeded and the remaining bread wheat and barley varieties were seeded on 18. Dec. Growth from bread wheat varieties seeded on 13 Dec was better than growth of varieties seeded on 18 December.

## Next steps

The dual purpose trials in Marchouch and El Koudia station will be repeated in the next planting season which begins in August 2019..

The trials on annual forage production with cereals and forage legumes will focus on barley and triticale in mixtures with vetch, grasspea and forage pea suitable for dry areas. Sulla as forage legume is an interesting alternative to alfalfa because its water use efficiency is better than the others. However, availability of sulla seeds is a problem, thus continued activities with sulla will depend on the seed availability.