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Irrigated forage productivity in the area of Syrt (Northern Libya)

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Abstract. The construction of the Great Man Made River started and completed by the former Libyan Government, allowed the irrigation of many farms in the northern part of Libya cultivating food and forage crops. A trial has been done in 2009 in the Syrt irrigated area few months before the start of the war, in order to compare the productivity of irrigated forages. The trial was managed thanks to agreements of "The Italian Agronomic Institute for Overseas" (Ministry of Foreign), University of Florence, and University of Syrt. Initial forage crops compared were oats (*Avena sativa*), vetch (*Vica sativa*), intercropping of oats+vetch, Chickpea (*Cicer arietinum*), field bean (*Vicia faba* var. *minor*). Our results suggest interesting potentialities in terms of yield but difficulties due to weeds diffusion. Further research would be needed, as soon as the new social conditions will be secured, especially comparing cool season forages and some tropical species.

Keywords. Irrigated forages – Overgrazing reduction.

Productivité des fourrages irriguées dans la région de Syrte (nord de la Libye)

Résumé. *La construction du Grand Fleuve Artificiel au cours de l'ancien gouvernement libyen, a permis l'irrigation de nombreuses fermes dans la partie nord du pays, pour les cultures alimentaires et la production de fourrage. Un essai a été réalisé en 2009 dans la zone irriguée de Syrte quelques mois avant le début de la guerre, afin de comparer la productivité des cultures fourragères irriguées. Le processus a été géré grâce aux accords de l'Institut Agronomique pour l'Outre-mer d'Italie (ministère des Affaires étrangères), de l'Université de Florence et de l'Université de Syrte. Les plantes fourragères initialement comparées sont l'avoine (*Avena sativa*), la vesce (*Vicia sativa*), l'association avoine+vesce, le pois chiche (*Cicer arietinum*), et la féverole (*Vicia faba *var*. minor*). Nos résultats suggèrent des potentialités intéressantes en termes de rendement, mais des difficultés subsistent dues à la diffusion des mauvaises herbes. D'autres recherches seraient nécessaires dès que les nouvelles conditions sociales seront assurées, en particulier en comparant des fourrages tempérés et certaines espèces tropicales.*

Mots-clés. *Plantes fourragères irriguées – Réduction du surpâturage.*

I – Introduction

Libya imports most of the dairy products consumed, as well as feeds for animals; therefore there is a strong need for establishing a local milk production and transformation industry and also for identifying more suitable crops to support dairy cow farms (Adrawi, 2009; Gamal Ghashut, 2005).

The former Government of Libya had carried out a plan to develop agriculture as part of a wider project of sedentarization and urbanization. As a part of this policy, the "Great Man-made River" project was built over 2.000 km to carry water (Abdelrhem *et al.,* 2008) to each small farm (5 hectares each). Thanks to the water of the "Great Man-made River", the Libyan country had increased considerably the potential of producing foods, forages and animal products.

An important agronomical issue related to the use of water for irrigation is the choice of species to crop. Our research analyzed the productivity of irrigated forages in Syrt coastal area, in the fields of the Experimental Centre for milk production and transformation, established in compliance with the agreements undertaken between Italy and Libya in 1998. The Italian Ministry of Foreign Affairs has entrusted the realization of this program to the Agronomic

Institute for Overseas of Florence, which has worked in partnership with the Shabiyah of Syrt and the Al Tahadi University of Syrt as local institutions, and in cooperation with the University of Florence.

II – Materials and methods

The research was done at the Experimental Research Centre for Livestock and forages in the Syrt region, built on 100 hectares of land at 15 km from Syrt. All experimental plots are surrounded by *Eucalyptus* spp. and *Acacia spinosa*. All data were collected at the end of March 2009 because at that period the arrival of drought is quite fast and large amount of water is necessary to support further production. Seven crops were compared, each repeated three times with random distribution on the field (three randomized blocks with seven plots each). Each forage plot was 10x20 meters (200 m^2). The following plant species were sown after soil harrowing, in December of the year before the collection of data and irrigated by sprinklers for the production of forage biomass and/or legume seeds aiming to enrich livestock diets with high protein content:

Medicago sativa (Ms, alfalfa, for plant biomass)

Hordeum vulgaris (Hv, barley, for plant biomass)

Avena sativa (As, oats, for plant biomass)

Avena sativa + Vicia sativa (A+V, oats+vetch, for plant biomass)

Pisum sativum (Ps, field pea, mainly for legume seeds - proteins)

Cicer arietinum (Ca, chickpea, mainly for legume seeds - proteins)

Vicia faba var. *minor* (Vm, broad bean, mainly for legume seeds - proteins)

The measurements done were the following:

1) Weeds and bare soil in the crops. Linear analysis method (Warren Wilson, 1959). Three lines per plot, thus 9 per crop, each line of 20 m length, recorded every 50 cm. We recorded separately weed species, crop plant and bare soil, then we calculated the percentage each plant species contributed to the vegetation and the proportion of bare soil in the plots.
2) Forage biomass. A sampling area of 1 m^2 was mowed completely, that means 9 sample areas per crop. Weeds were removed manually and excluded from this calculation. The green biomass was weighted, then one sample of 500 grams taken from each plot, oven dried and then weighted to calculate the percentage of dry matter.

III - Results and discussion

1. Weeds and bare soil in the crops

The most frequently weed (Table 1) was *Emex spinosa* (17.91% on average for the seven crops). It is an annual plant of the *Polygonaceae* family. It has colonizing characteristics including drought tolerance, rapid growth, abundant seed production, seed dormancy and high dispersal abilities.

The second frequent plant was *Festuca arundinacea* (only 7.90% in the average of all plots), which is a rather drought tolerant grass well adapted also to the warm Mediterranean environment. All other weeds had only very little specific contributions and were occasional in our trial.

The bare soil has not been much anywhere in the trial and it had the minimum value in the combination *Avena sativa + Vicia sativa* var*. minor*, probably because of the good relationship and cooperation of the legume with the cereal has favored the development of the association. This suggests that intercropping legumes and grasses can be very useful in the sandy soils of the area.

The three grain legume crops contributed to the total plant biomass less than the others which can be resolved by introducing different *Rhizobium* strains than those naturally present. The most covering crops were *Medicago sativa* that is known to have a rapid growth and good cover, *Hordeum vulgare* and *Avena sativa* that are sown denser than legume pulses, and the association of *Avena+Vicia* that probably benefited of the association.

Table 1. Weeds specific contribution (%) in the seven forage crops of the trial, in order of presence. (MS = *Medicago sativa*, HV = H*ordeum vulgare*, As = *Avena sativa*, A+V = Association *Avena sativa + Vicia sativa*, Ps = *Pisum sativum*, Ca = *Cicer arietinum*, Vm = *Vicia faba* var*. minor*

Weed species	Specific Contribution (%) in the seven crops							
	Ms	***Hv***	***As***	***A+V***	***Ps***	***Ca***	***Vm***	**Aver.**
Emex spinosa	5.23	14.71	0.00	10.42	26.03	34.02	34.95	17.91
Festuca arundinacea	3.51	0.00	2.86	5.82	10.95	27.75	4,41	7.90
Lolium loliaceum	0.00	0.05	0.10	0.00	12,45	0,00	0,00	1.80
Solanum nigrum	0,00	3.23	3.22	0.00	0.00	0.00	0.05	0.92
Cynara cardunculus	0.00	4.84	0,00	0,00	0.00	0.11	0.12	0.73
Hippocrepis multisiliquosa	0.13	0.00	0.00	0.03	2,59	0,00	0,00	0.39
Hirschfeldia incana	0.00	0.12	0.00	0.00	0,00	0,00	2,38	0.36
Matricaria aurea	0.00	0.00	0.05	0.05	0,00	0,00	2,38	0.35
Chrysanthemum coronarium	0.08	0.00	0.00	0.00	0,00	0,00	1,47	0.22
Bare soil	8,74	5,47	8,93	1,16	4,61	5,96	4,41	5.61
Crop	82.31	71.58	84.84	85.52	43.37	32.16	49.83	63.81

2. Forage biomass

The most productive crop (Table 2) has been *Hordeum vulgare* (5.47 t/ha DM in the average of the replications). However, despite of the lower contribution of legume pulses in total biomass, these gave interesting productions of dry matter. Strangely the association of *Avena+Vicia* and that of *Medicago sativa* that had given very high soil covers did not produce much.

The recorded production of dry biomass does not appear great as compared to those in the Northern Mediterranean, however it was considerably higher than expected from native vegetation and without irrigation in a few months. Further production can be supported by irrigation for an estimated growing period of 6-8 months during which the total amount will increase.

IV – Conclusions

The irrigation capacity provided by the Great Man Made River can increase much the productivity of crops in comparison to wild vegetation. However it would be convenient to limit the use of irrigation to produce what is really needed, including crops for food and a limited quantity of forages just to sustain cow milk production that is important especially for children.

A question comes about the choice of the forage species that we tried and that are all C_3 plants, whilst the hot environment and water availability could make convenient to crop C_4 species which are more productive and also more drought tolerant.

Table 2. Forage biomass (dry matter yield t/ha and % on the green biomass) of the seven crops of the trial. Values in column with different letters are significantly different at P=0.05 (ANOVA by Sistat)

Forage crop	Dry matter	
	t / ha	%
Hordeum vulgare	5.47 a	21.6
Pisum sativum	3.71 b	17.3
Cicer arietinum	3.57 bc	20.9
Avena sativa	2.44 bc	15.9
Vicia faba var. *minor*	2.30 bc	14.2
Avena sativa +Vicia sativa	2.02 bc	16.2
Medicago sativa	1.96 c	14.0

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