Assessment of the Nutritional Value of Forage mixtures and Sheep Response

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Introduction

Oat is the commonly grown cereal forages in Tunisia. The nutritional quality of these cereal forages is low due to the unsuitable agronomic practices and harvesting and storage conditions. Livestock owners have to rely on wheat bran, cereal stubbles with an overuse of cereal grains and commercial concentrates, making, therefore, livestock management very costly and unsustainable. On another hand, one of the main pillars for successful adoption of CA in crop-livestock integrated systems is the enhancement of crops diversification and rotations. Intercropping cereal to forage legume is one of the project objectives. The benefit of forage crop mixture is to better valorize the ecological, nutritional and agronomic differences of mixed species in terms of production, quality and environmental benefits. Forage cropping in parallel with cereal cropping would be the solution to achieve the tradeoff between soil mulching and stubble uptake by animals. Their main advantages are higher forage production and quality compared to monoculture, reduced nitrogen inputs and functional traits involved in weed competitiveness and cycle disease breakdown. To increase the quality of produced forage, enhance soil quality and diversify the crop rotation system, the project tested, evaluated and validated several crops mixtures combinations under CA practice in the first year. For the second year of the project, CLCA team started the scaling of some validated forage mixtures and new forage varieties and also continued testing/validating other crops mixtures options.

Component 1. Nutritional characterization of different forage mixtures.

Experiment 1. Comparative study of three forage mixtures (farm level).

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This work aim to compare the nutritional value of forage mixtures to the classic one. Two tri-specific cereal-legume mixture were studied and compared to the classic Vetch-Oat one. They were implemented at farm level. Implemented mixtures are V70-A15-T15 (Vetch 70% - Oats 15% -Triticale 15%) installed in two sites, V60-A7-T33 (Vetch 60% - Oats 7% -Triticale 33%) and V70-A30 (Vetch 70% -Oats 30%).

Mixtures V70-A15-T15, V60-A7-T33 and V70-A30, produced respectively 10.9 and 11.9, 10.6 and 11.1 t DM of hay ha-1 (**Figure 1)** which is indicative of a very high forage potential. These yields contained same vetch and cereal proportions (**Figures 2, 3)**. They contained a small quantity of weeds (**Figure 4)**. The chemical composition revealed a nutritional importance of all forage mixtures in terms of protein (CP> 10 % DM, table 1). The proportion of vetch in the mixture explains the high protein content, as these two parameters are positively correlated (table 2). These results allow us to conclude that these forage mixtures present a promising option to produce high nutritional quality hay allowing better animal performance at lower cost.

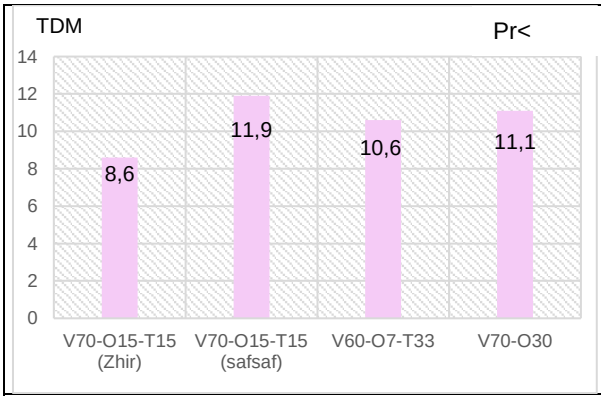

Figure 1. Mixtures yields

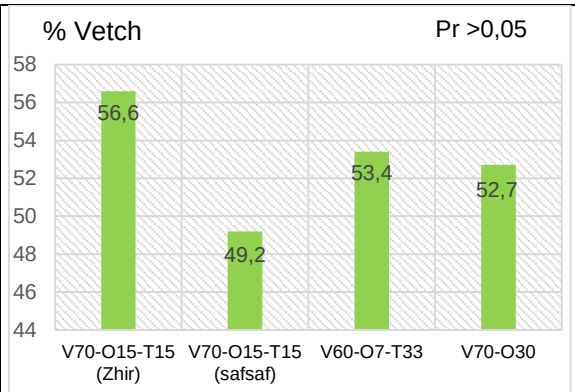

Figure 2. Vetch proportion in Mixtures

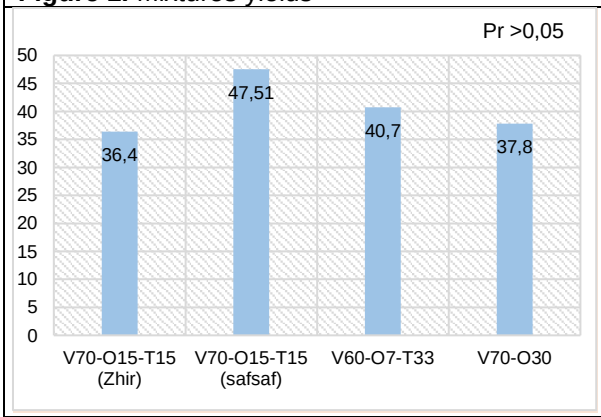

Figure 3. Cereals proportion in Mixtures

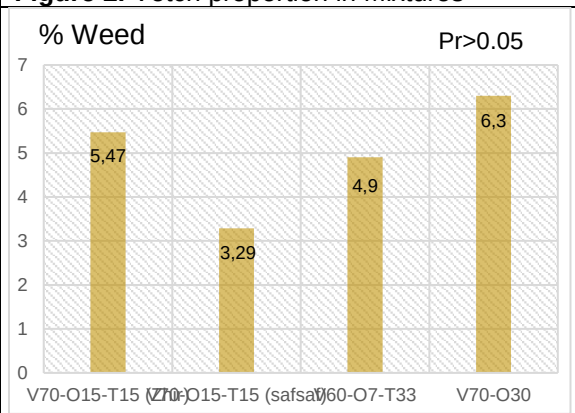

Figure 4. Weed proportion in Mixtures

Table 1. Chemical composition of different mixtures (g/kg MS).

	Mixtures					
	1	2	3	4	ESM	Pr
DM	25.0	24.7	26.0	24.0	1.45	0.8048
OM	92.6a	90.9b	92.0a	91.2b	0.15	0.0002
CP	11.1a	13.7b	10.4a	14.4b	0.41	0.0003
NDF	52.6	61.9	58.0	55.4	6.81	0.7999
ADF	31.7	39.7	41.6	34.0	2.86	0.1199
ADL	5.17a	8.12b	7.23bc	6.33ac	0.60	0.0417
Hemicelluose	20,9	22,2	16,4	21,4	1.54	0.0403
Cellulose	26,53a	31,58ab	34,37b	27,67a	2.03	0.0451

DM : Dry matter ; OM : organic matter ; CP: Crude protein ; NDF : Neutral detergent fiber; ADF : Acid detergent fiber ; ADL : Acid detergent lignin.

Table 2. Correlations between mixtures chemical composition and vetch proportion in hay

	% Vetch	**CP**	**NDF**	**OM**
% Vetch				
CP	0.0336 Pr=0.682			
NDF	-0.3235 Pr=0.305	-0.0711 Pr=0.011		

OM	0.3386 Pr=0.282	0.8199 Pr=0.001	-0.2992 Pr=0.345	

Experiment 2. Nutritional characterization of produced forages.

In comparison to the common produced hay in Tunisia (Oat hay), five different mixtures were implemented in nine regions at farm level to produce hay. The composition of different mixtures is the following: Two of them were made of two species (1 legume and 1 cereal), the two other were made of three species (1 legume and 2 cereal) and the last one contained four species (2 legume and 2 cereal). Selected regions, farmers and mixture kinds are mentioned in table. Three samples of mixtures hay were taken to be analyze for their nutritional value with a total of 72. DM, OM and different sequences of fiber were analyzed. However, Crude protein and fat content are in progress. Results show significant differences in chemical composition. Different dry matter (DM), organic matter (OM) and Fiber (NDF, ADF, ADL) content is tightly related to species used as the used of cereal increase DM and fiber contrarily to legume s witch increase OM and crude protein. Crude protein content of all new mixtures was higher than those of oaten hay and oat-vetch hay. The highest content was obtained in Vetch-Triticale-Oat –Fenugreek hay. It can be concluded that the presence of legume at high proportion enhance crude protein and consequently the nutritional value of hay.

Table 3. Region, farmers and produced hay

	Region	**Farmer**	**Hay**
1	Sidi hmed salah _ sarrat	Chokri Massoudi	Oat
2	Ksar tir	Nour Eddine Tridi	Vetch-Oat
3	Lahmira	Lazher Bouzayen	Vetch-Oat
4	Chouarnia	Jamel Sehli	Vetch-Oat
5	Saouef	Ferme OEP	Vetch-Oat
6	Amayem	Mounir Nasr	Vetch- Triticale
7	Lahmira	Lazher Bouzayen	Vetch- Triticale
8	DOUAR HAJ AMOR	Raouf	Vetch- Triticale
9	Chouarnia	Taoufik Ben Ammar	Vetch-Triticale-Oat
10	Amayem	Mounir Nasr	Vetch-Triticale-Oat
11	Chouarnia	Taoufik Ben Ammar	Vetch-Triticale-Barley
12	Djbel chaara	Ahmed Moussi	Vetch-Triticale-Barley
13	Hfaisiya	Zied Massoudi	Vetch-Triticale-Oat -Fenugreek

Table 4. Chemical composition of hays

Hay	DM	OM	CP	NDF	ADF	ADL	Hemicellulose	Cellulose
1	95.7 a	93.1 a	6.84 a	61.6 ab	37.7 a	5.1 ab	23.9 a	32.6 a
2	95.6 a	93.8 a	6.89 a	71.9 a	41.4 a	6.3 bc	30.0 b	35.1 a
3	95.5 a	93.3 a	6.52 a	67.6 a	35.4 ab	7.2 c	32.2 b	28.1 ab
4	97.0 a	93.9 a	7.28 a	60.5 b	29.0 b	4.3 a	31.4 b	24.7 b
5	96.1 a	93.0 a	7.99 b	60.7 b	35.5 a	4.8 a	25.2 a	30.6 ab
6	96.5 a	93.0 a	8.01 b	61.8 b	36.5 a	6.2 bc	25.3 a	30.3 ab
7	95.7 a	94.2 a	7.99 b	72.1 a	36.1 a	7.3 c	36.0 c	28.8 ab
8	96.1 a	92.2 ab	7.78 b	63.7 ab	36.4 a	4.4 a	27.3 a	31.9 ab
9	89.8 b	91.5 b	8.28 bc	65.7 ab	41.9 a	6.7 bc	23.8 a	35.2 a
10	94.8 a	93.2 a	8.75 c	64.5 ab	37.9 a	6.2 bc	26.5 a	31.8 ab
11	90.1 b	91.6 bc	9.06 c	66.7 ab	41.9 a	6.6 bc	24.8 a	35.4 a
12	95.3 a	92.4 ac	7.90 b	67.1 ab	43.5 a	7.0 c	24.6 a	36.4 a
13	93.0 a	92.2 ab	11.23 d	69.2 ab	45.2 a	6.8 bc	24.0 a	38.3 a
SEM	0.35	0.28	0.18	2.10	1.80	0.38	0.74	1.48
Pr	< 0.0001	< 0.0001	< 0.0001	0.0031	< 0.0001	< 0.0001	< 0.0001	< 0.0001

Succeeding forage crops and mixtures seems to be the best solution to convince farmers to adopt CLCA package. Wherever crop mixtures were implemented, farmers were convinced by its nutritional superiority compared to oaten hay they already produce.

Component 2. Effect of vetch on some reproduction parameters.

Reproductive failure is the most costly problem faced by livestock producers. The major reason livestock fail to reproduce is poor nutrition that has a direct bearing upon reproductive performance. Several critical periods in the life of a ewe dictate her fertility and prolificacy. Fortunately, monitoring nutrition during these critical periods enhance ewes reproductive success. Thus, ewes kept in acceptable condition before breeding normally produce more lambs if they are flushed or given the chance to gain weight before and during the breeding season. From another angle, the major factors that affect profitability in sheep production are the total number and the total weight of lambs produced per ewe. In addition, some farm-flock producers find it advantageous to plan their breeding season so that all ewes lamb at approximately the same time. In the first phase of CLCA project, breeders observed that grazing vetch in spring season enhance sheep fertility and prolificacy and gather ewe lambing. To confirm this ascertainment, an experiment was carried in the Bourbiaa experimental station. Fifty

ewes were flushed before breeding season. They were allowed to graze vetch during spring.

The assessment of ewe behavior showed that animals spent 70% of grazing period in consuming vetch (figure 5). This behavior highlight the palatability of vetch. The greater feeding value of legume forage species results from both greater voluntary intake and greater nutritive value, which explain the better weigh gain and the ewe's body conditions at mating (figures 6, 7). The consumption of vetch alone without any supplementation could reduce production cost. Unfortunately, during the Covid containment and due to unexpected conditions, we were obliged to reduce the number on ewes to thirty without using a control group. Thus, we can't rely on results on reproduction parameters to conclude. These preliminary results from this assay can confirm the positive effect of vetch on animal response in term of intake and body condition. However, an in-depth study must be carried to confirm the famer observation about the vetch effect on reproduction parameters.

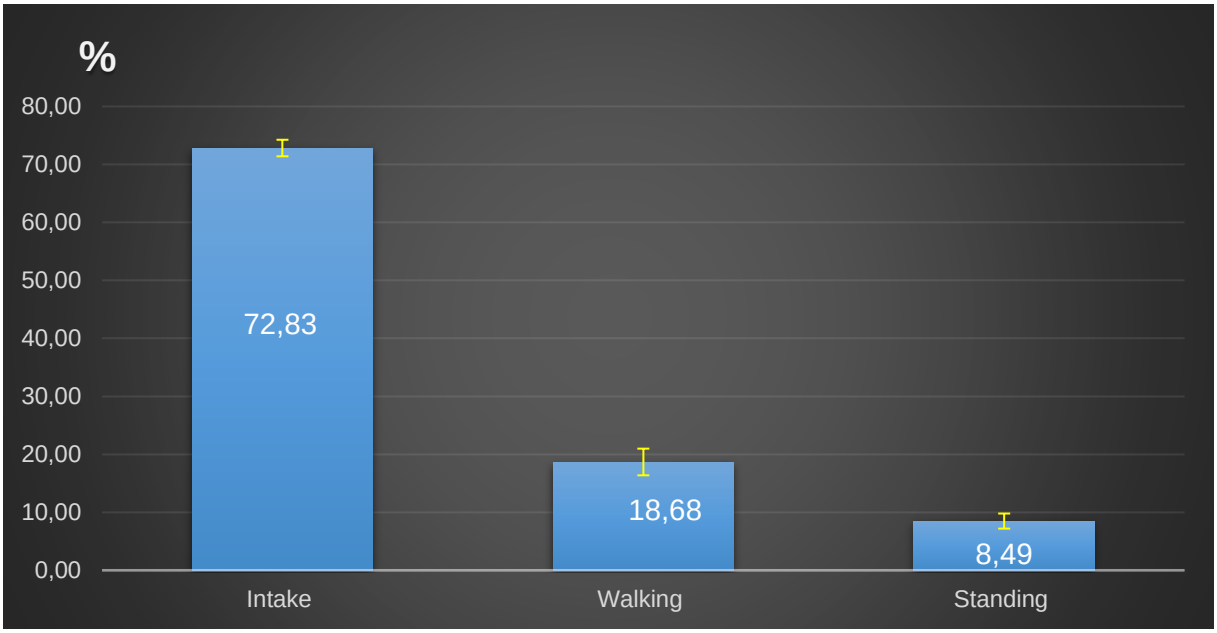

Figure 5. Ewes behavior

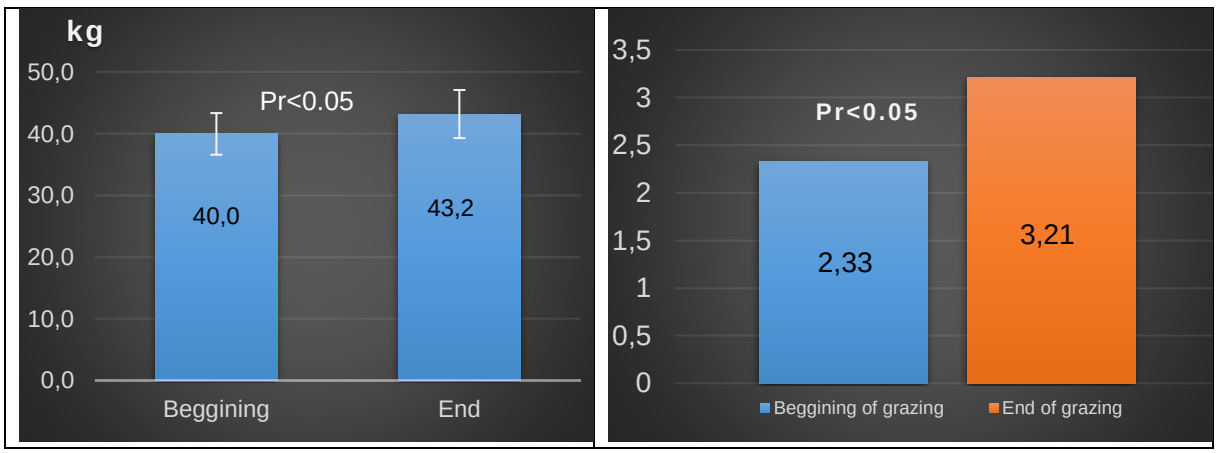

Figure 6. Live weight of ewes	**Figure 7.** Body condition scores average of ewes