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Abstract. The aim of this work was to study the effect of agricultural practices (Conventional and conservation agriculture: Conv.A and CA respectively) on live weight variation and body condition scoring (BCS) of Barbarine ewes in Tunisian semi-arid conditions. The trial was carried out in the experimental station of INRAT (Region of Zaghouan) in two plots of bread wheat stubble, cultivated respectively according to Conv. A and CA conditions. Each one was dividedinto 3 electrically fenced subplots and each subplot had an area of 1665 m^2 for a stocking rate of 30 ewes/ha.Thirty Barbarine breed ewes (Initial average weight 38 ± 1.86 kg) were divided into 6 homogeneous groups of 5 ewes each (3 groups for each agricultural system: Conv.A and CA). Animals grazed during a period of 45 days. Live Weight (LW), Daily Live Weight Gain (DLWG) were determined 4 times after the start of the experiment (every 10 days) and BCS was determined at the beginning of the experiment and 40 days after. Results showed that Live Weight increased significantly from the first weighing time until the end of the experiment both in Conv. A and CA ($P<0.05$, + 3.94 and 3.85 kg respectively). In the second period, DLWG decreased significantly in CA plot ($P<0.05$, -40.1 g/d), affecting the body weight which decreased but not significantly. Then, the live weight increased in the third period and it was maintained until the end of the experiment with a positive DLWG registered on ewes. The same trends of variation in LW were found in Conv.A and CA. For all the weighing times, no differences in LW and DLWG values between agricultural practices were noted. Results relative to BCS variation showed that no significant differences were observed in lumbar region score between the two investigated agricultural practices in the 2 measurement periods. The variation of tail region score according to agricultural practices at the start and the end of experiment showed that both in Conv. A and CA, the tail region score increased significantly ($P<0.01$; $P<0.0001$, respectively for Conv. A and CA).Statistically, the two investigated agricultural practices (Conv.A and CA) didn't affect the tail region score whatever the measurement time. It was concluded that in these experimental conditions, no differences were found in performances between the two agricultural practices.

Keywords. Ewes – Stubble – Grazing – Conservation agriculture – Performances.

Performances des brebis de race Barbarine pâturant sur chaume de blé sous l'agriculture conventionnelle et l'agriculture de conservation dans la zone semi aride Tunisienne

Résumé. *L'objectif de ce travail était d'étudier l'effet des pratiques agricoles (Agriculture conventionnelle et agriculture de conservation : Conv.A et CA respectivement) sur la variation du poids vif(PV) et la note d'état corporel (NEC) des brebis de race Barbarine dans les conditions semi-arides tunisiennes. L'essai a été mené dans la station expérimentale de l'INRAT (Région de Zaghouan) dans deux parcelles de chaume de blé, cultivées respectivement selon l'agriculture conventionnelle et l'agriculture de conservation. Chaque parcelle était divisée en 3 sous-parcelles électriquement clôturées ayant chacune une superficie de 1665 m^2 pour une charge de 30 brebis / ha. Trente brebis de race Barbarine (Poids Moyen Initial 38 ± 1,86 kg) ont été réparties en 6 groupes homogènes de 5 brebis chacun (3 groupes pour chaque système agricole: Conv.A et CA). Les animaux ont pâturé pendant 45 jours. Le poids vif (PV) et le Gain Moyen Quotidien (GMQ) ont été déterminés 4 fois après le début de l'expérience (tous les 10 jours) et la NEC a été déterminée au début de l'expérience et*

40 jours après. Les résultats ont montré que le poids a augmenté significativement dés le début jusqu'à la fin de l'expérience à la fois dans Conv. A et CA (P <0,05, + 3,94 et 3,85 kg respectivement). Au cours de la deuxième période, le GMQ a diminué de manière significative dans CA (P <0,05, -40,1 g / j), affectant le poids corporel qui a diminué mais non significativement. Ensuite, le poids vif a augmenté dans la troisième période et il a été maintenu jusqu'à la fin de l'expérience avec un GMQ positif enregistré chez les brebis. Les mêmes tendances de variation du poids vif ont été signalées dans les deux types d'agriculture. Pour tous les temps de pesée, aucune différence du PV et du GMQ n'a été enregistrée entre les pratiques agricoles. Les résultats relatifs à la NEC n'ont mentionné aucune différence significative dans le score de la région lombaire entre les deux types d'agriculture dans les deux périodes de mesure. Le score de la région caudale dans Conv.A et CA au début et à la fin de l'expérience a augmenté de façon significative (P <0,01; P <0,0001, respectivement pour Conv. A et CA). Statistiquement, les deux types d'agriculture étudiés (Conv.A et CA) n'ont pas affecté le score de la région caudale quel que soit le temps de mesure. On a conclu que, dans ces conditions expérimentales, aucune différence n'a été enregistrée quant aux performances entre les deux pratiques agricoles.

Mots-clés. *Brebis – Chaume – Pâturage – Agriculture de conservation – Performances.*

I – Introduction

Conservation agriculture (CA) is based on No-Tillage which requires a permanent mulching as a crop residue or a cover crop and an adapted rotation. In Tunisia, the total area cropped under CA context, mainly no-tillage increased from 27 ha in 1999 to nearly 12 000 ha in 2014 (INGC, 2014). Generally, CA relies on three major principles:

(i) Maintenance of a permanent vegetative cover or mulch on the soil surface,

(ii) Minimal soil disturbance,

(iii) Diversified crop rotation.

The integration of crop-livestock under CA holds promise to improve the efficiency and sustainability of production systems, but this is conditioned by good understanding of CA principles and appropriate use of corresponding packages. The farmer can introduce forage crops into the crop rotation, thus extending it and reducing pest problems. Forage species could be used as dual-purpose crops for fodder and soil cover. However, tradeoffs between the use of stubbles for livestock feeding or to cover the soil have to be resolved, particularly in dry lands where fodder potential is low (FAO, 2006).This concept of CA seemed to be apparently incompatible with livestock extensive system and if it is adopted, competition with livestock feeding needs to be optimized. Unfortunately, the crop-livestock interaction in conservation agriculture has rarely been studied and little data are available in the literature to resolve this conflict. The aim of the current study was to evaluate the effect of agricultural practices (Conventional and conservation agriculture: Conv.A and CA respectively) on live weight variation and body condition scoring (BCS) of Barbarine ewes in Tunisian semi-arid conditions.

II – Material and methods

1. Experimental area

The trial was carried out in the experimental station of INRAT (24 km from Tunis, semi-arid: 350 mm of rainfall). During the experimental period, animals grazed on stubble of bread wheat cultivated according to Conv.A and CA. Two plots (last year crop: vetch produced in CA conditions) of 0.5 ha each were respectively reserved to the trial (Previous crop: Vetch; agricultural practice: CA since 3 years). Each one was divided into 3 electrically fenced subplots and each subplot had an area of 1665 m^2 for a stocking rate of 30 ewes/ha. In the 2 plots, bread wheat from the variety AC-

SAD was sowed in the 25thof November 2014 at a density of 160 kg/ha. In CA plot, a treatment by herbicide (glyphosate 180 g of AI equivalent to 3L of commercial product/ha) was applied before sowing. The 2 plots were fertilized using Ammonitrate (150 kg/ha) and Diammonium phosphate (DAP) (100 kg/ha). The *two* plots were weeded with 2.4.D (2 applications). Wheat was harvested on the 12th of June 2014 at a cutting height of about 30 cm. The registered grain yield was of about 1.3 and 1.5 T/ha respectively for Conv.A and CA.

2. Animals

A total of 30 Barbarine ewes (Initial average weight 38 ± 1.86 kg) were selected from the experimental station of Bourbiaa (INRAT) and used for the experiment. They were divided into 6 homogeneous groups of 5 ewes each and received an anthelmintic treatment and were vaccinated against enterotoxaemia. They were housed in collective boxes and marked on, using different colors of painting to be easily identified and separated per treatment and plot before leaving for grazing. They had access to water 3 times a day.

3. Experimental design, sampling and measurements

One main factor was studied: Agriculture practices (Conv.A and CA) and 3 groups of 5 ewes each were reserved for each agricultural practice (3 groups in the correspondent 3 subplots for each agricultural practice). During the experiment, ewes grazed twice a day (from 5 h to 8 h and from 16 h to 18 h or 17h to 19 h) with a total grazing duration of 5 hours per day. The experiment lasted from the 15-07-2014 to the 28-08-2015, with a total duration of about 45 days. To monitor the ewes live weight variation, the animals were weighed early in the morning (5h) before the start of grazing. Live weight and body condition scoring (BCS) were determined 4 times after the start of the experiment (every 10 days). Live weight and daily live weight gain by period (LW and DLWG respectively) were calculated.

4. Statistical analysis

Available data were analyzed according to GLM procedure, using Statistical Analysis System software (SAS, 2002). The model included: Agricultural practices (Conv.A. or CA), period and interactions (animal was considered as co-variable).The Student-Newman-Keuls (SNK) test was used to compare treatment effects. When P-value is below 5%, the treatment effect was considered significant.

III – Results and discussion

1. Ewes' performances

Live weight and DLWG results according to agricultural practices and period are presented in Figures 1 and 2. Live weight increased significantly from the first weighing time until the end of the experiment both in Conv.A and CA ($P<0.05$, + 3.94 and 3.85 kg respectively for Conv.A and CA). In the second period, DLWG decreased significantly in CA plot ($P<0.05$, -40.1 g/d), affecting the body weight which decreased but not significantly. Then, the live weight increased in the third period and it was maintained until the end of the experiment (Figure 1), with a positive DLWG registered on ewes (Figure 2). Figure 2 shows that in the first period in CA, animals registered the highest DLWG (278.6g/d), but the difference with Conv.A animals was not significant, probably due to individual variations. This can be explained by the higher quality of stubble at the beginning of the experiment which is rich of heads, presenting a high source of energy.

The last finding could claim that biomass in plots was not limiting and enough to sustain live weight increase. Results presented in Figure 1 indicated that generally in this feeding system, body con-

dition of animals was preserved and stubble could contribute to safeguard livestock even in absence of supplementation (Moujahed *et al.,* 2015). In this context, Köller (2003) claimed that livestock could be fully integrated into conservation agriculture, when more than 30% of the residues from the previous crop are left on the ground as mulch. Results showed that, the same trends of variation in LW were found in Conv.A and CA. For all the weighing times, no differences in LW and DLWG values between agricultural practices were noted.

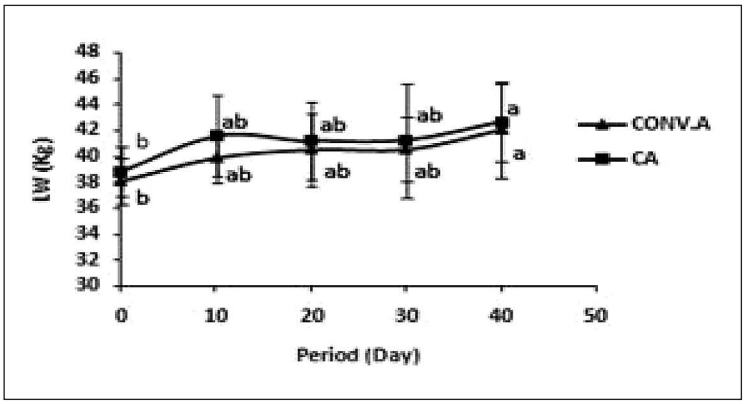

Fig. 1. LW variation depending on agriculture conditions.
a, b: Different letters indicate that the difference between the treatment effects are significantly different (P<0.05).

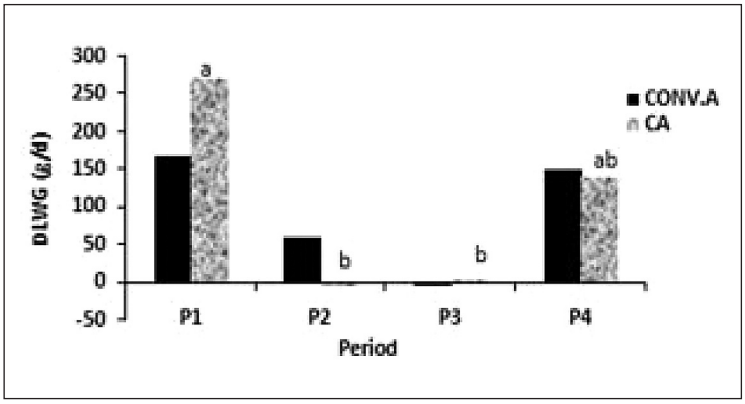

Fig. 2. DLWG variation depending on agriculture conditions.
a, b: Different letters indicate that the difference between the treatment effects are significantly different (P<0.05).

2. Body condition scoring variation according to agricultural practices

A. Lumbar region score

The variation of lumbar region score presented in Table 1showed that at the beginning of the experiment, ewes registered a lumbar region score ranging between 1.45 and 1.5 respectively in Conv.A and CA. At the end of the experiment, ewes presented a score value of about 1.43 in Conv.A

and 1.46 in CA. Results mentioned that no significant differences were observed in lumbar region score between the two investigated agricultural practices in the 2 measurement period. But it's worthy to note that the body state as observed trough the lumbar region was relatively low, but was conserved among the experiment duration, even without supplementation.

Table 1. Lumbar region score variation according to agricultural practices

Period (Day)	0	40	SEM	Significance
CONV.A	1.45	1.43	0.021	NS
CA	1.5	1.46	0.016	NS
SEM	0.043	0.042		
Significance	NS	NS		

SEM: Standard error of the mean.
NS: No Significant effect.

B. Tail region score

The variation of tail region score according to agricultural practices at the start and the end of experiment (Table2) showed that both in Conv. A and CA, the tail region score increased significantly (P<0.01; P<0.0001, respectively for Conv. A and CA). In Conv.A, ewes registered a score value of about 3.6 at the beginning, which increased to attend 4.21 at the end of the experiment. In CA, ewes started the experiment with a tail region score of about 3.53 to attend 4.25 after 40 days. Statistically, the two investigated agricultural practices (Conv.A and CA) didn't affect the tail region score whatever the measurement time.

Table 2. Tail region score variation according to agricultural practices

Period (Day)	0	40	SEM	Significance
CONV.A	3.6^{a}	4.21^{b}	0.064	**
CA	3.53^{a}	4.25^{b}	0.06	***
SEM	0.12	0.096		
Significance	NS	NS		

SEM: Standard error of the mean.
NS: No significant effect.
**: P<0.01; ***: p<0.001.

IV – Conclusions

Under the experimental conditions of the current work, the two investigated agricultural practices (Conv.A and CA) resulted in similar performances of Barbarine ewes. Indeed, for all the weighing times, no differences in LW and DLWG values between agricultural practices were noted. Also, The Body Condition Score was not affected both in Conv.A and CA whatever the measurement time which proves that biomass was available enough to feed animals.

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