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Evaluation of straw quality of barley varieties for animal feeding

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SUMMARY - Barley crop is grown by most farmers in Morocco. Its main use is for animal feeding as grain, straw or grazed as forage early in the season. Thirteen varieties have been released since 1976 on the basis of their grain yield advantage over the landraces. No work has been carried out to assess their straw production and quality although these attributes are major constraints to a larger adoption of the new varieties by farmers. The main objective of this study is to evaluate the straw quality of available varieties. Nine barley varieties: ACSAD 60, Aglou, Azilal (two-rows), the landraces: Merzaga 077, Rabat 071, and the new six-row varieties: Arig 8, Annoceur, ACSAD 176 and INRA 1758, were evaluated in this study. The agronomical trial was conducted in 1995 at Sidi El Aydi experiment station. The collected straw samples were analysed for their concentration in nitrogen (N) and neutral detergent fiber (NDF). They were also used to study the dry matter (DM) and N degradability in the rumen. They were further used to evaluate the palatability of the different straws for sheep. Preliminary results have shown significant differences among barley varieties for their straw chemical composition, DM and N degradability in the rumen, and palatability for sheep. These criteria could be strong arguments to include straw quality as a selection criterium in the cereal breeding program.

Key words: Barley, straw, quality, palatability, sheep, degradability.

RESUME - "Evaluation de la qualité des pailles de plusieurs variétés d'orge en alimentation animale". La plupart des agriculteurs marocains cultivent de l'orge. Il trouve sa plus grande utilisation pour l'alimentation animale comme grain, paille ou pâturé comme fourrage tôt pendant la saison. Treize variétés ont été commercialisées depuis 1976 sur la base de leur avantage pour le rendement en grain par rapport aux variétés sauvages. Aucun travail n'a été mené pour évaluer la production et la qualité de leur paille quoique ces attributs soient des contraintes majeures pour une plus vaste adoption de ces nouvelles variétés par les agriculteurs. Le principal objectif de cette étude est d'évaluer la qualité de la paille des variétés disponibles. Neuf variétés d'orge : ACSAD 60, Aglou, Azilal (deux rangs), les variétés sauvages : Merzaga 077, Rabat 071, et les nouvelles variétés à six rangs : Arig 8, Annoceur, ACSAD 176 et INRA 1758, ont été évaluées dans le cadre de cette étude. Les essais agronomiques ont été menés en 1995 à la Station Expérimentale de Sidi El Aydi. Les échantillons de paille prélevés ont été analysés pour leur concentration en azote (N) et en fibre neutro-détergente (NDF). Ils ont également été utilisés pour étudier la dégradabilité de la matière sèche et de l'azote dans le rumen. Puis on a évalué la palatabilité des différentes pailles pour les ovins. Les résultats préliminaires ont montré des différences significatives parmi les variétés d'orge en ce qui concerne la composition chimique de leur paille, la dégradabilité de la matière sèche et de l'azote dans le rumen, et la palatabilité pour les ovins. Ces critères pourraient représenter des arguments de poids pour incorporer la qualité de la paille comme critère de sélection dans le programme d'amélioration des céréales.

Mots-clés : Orge, paille, qualité, palatabilité, ovins, dégradabilité.

Introduction

Barley crop is grown by most farmers in Morocco. Its main use is for animal feeding as grain, straw or grazed as forage early in the season. Thirteen varieties have been released since 1976 on the basis of their grain yield advantage over the landraces. No work has been carried out to assess their straw production and quality although these attributes are major constraints to a larger adoption of the new varieties by the farmers (Maurice Saade *et al.*, 1993). The main objective of this study is to evaluate the straw quality of available varieties.

Materials and methods

Nine barley varieties: ACSAD 60, Aglou, Azilal (two rows: 2 R), the landraces (6 Ro): Merzaga 077, Rabat 071, Arig 8, and the new six-row (6 R) varieties: Annoceur, ACSAD 176 and INRA 1758, were evaluated in this study.

The agronomical trial was conducted in 1995 at Sidi El Aydi experiment station. The varieties were arranged in a randomized complete block design with three replications. Each plot was of six rows of five meters long with 0.3 m row spacing. Because of the severe drought of this year, the trial was irrigated.

The collected straw samples were analysed for their concentration in nitrogen (N) and neutral detergent fiber (NDF). They were also used to study the straw dry matter (DM) degradability in the rumen. Incubation periods were 0, 2, 4, 8, 24, 48, and 72 hours. The same straw samples were further used to evaluate the palatability of the different straws for sheep. Varieties were offered to the animals in pairs. Nine ewes were used to test the 36 pairs of straws over four successive runs of five minutes each. Twenty grams of chopped straw from each variety were offered to the sheep in two similar buckets. Refusals were weighed after the five minutes and straw intake calculated. This trial was replicated three times. Statistical analyses were done using the procedures of SAS.

Results and discussion

Straw chemical composition

Statistical analysis of CP and NDF data of straw samples has shown the existence of variation among varieties (Table 1). Thus, the relatively low NDF concentration varied between 54 and 63% DM. Three homogeneous groups of varieties could thus be identified. The CP concentration, particularly high, varied between 8.41 and 10.91% DM with two homogeneous groups of varieties. If we consider the two constituents at the same time, the nine varieties could be sorted into three groups of varieties. The first group would include the two varieties Arig 8 and Rabat 071 with the highest CP and the lowest NDF concentrations. This group is supposed to have a good nutritive value. The second group would include Merzaga 077, ACSAD 176, INRA 1758, Annoceur, and Aglou all having intermediate values. ACSAD 60 and Azilal constitute the third group with the lowest CP and the highest NDF concentrations, supposedly having the lowest nutritive value. Based on this type of analysis, the two-rows varieties would be ranked low and thus would have low nutritive value which confirms most farmers opinion about this type of varieties.

Table 1. Crude protein (CP) and neutral detergent fibre (NDF) concentration (%) of barley straw

Variety (year inscription in catalogue)	Row type	CP (% DM)	NDF
Arig 8 (73)	6	10.9 ^a	56.0 ^c
Rabat 071 (56)	6	10.6 ^a	54.0 ^c
Merzaga 077 (56)	6	10.4 ^{ab}	59.6 ^b
ACSAD 176 (84)	6	10.0 ^{ab}	61.0 ^{ab}
INRA 1758	6	9.9 ^{ab}	59.4 ^b
Annoceur (91)	6	9.8 ^{ab}	60.4 ^{ab}
Aglou (88)	2	9.2 ^{ab}	60.9 ^{ab}
ACSAD 60 (84)	2	8.5 ^b	62.6 ^a
Azilal (89)	2	8.4 ^b	62.8 ^a
LSD (0.05)		2.0	3.0

a,b,c: Means with different letters in a column differ significantly at P<0.05

Palatability

The analysis of straw palatability data with sheep has shown significant differences among varieties (Table 2). The nine varieties could be sorted into three groups of decreasing palatability. The most palatable varieties would be Aglou, ACSAD 60 and Rabat 071. The less palatable ones would be Azilal, INRA 1758 and ACSAD 176. With few exceptions, these results tend to show that the two-rows varieties have more palatable straw, and the new six-rows varieties have less palatable straw. These results would mean that in the case of straw, good palatability and high nutritive value do not necessarily go together. There must be some other factor or constituent that causes these variations.

Table 2. Results of barley straw palatability tests for sheep

Variety (year inscription in catalogue)	Row type	Ingested g (% offered)	Rank
Aglou (88)	2	16.7 (83.5) ^a	1
Acsad 60 (84)	2	14.3 (71.5) ^{ab}	2
Rabat 071 (56)	6	13.3 (66.5) ^{bc}	3
Arig 8 (73)	6	10.5 (52.5) ^{cd}	4
Merzaga 077 (56)	6	10.1 (50.5) ^{cde}	5
Annoceur (91)	6	9.5 (47.5) ^{def}	6
Azilal (89)	2	7.6 (38.0) ^{def}	7
INRA 1758	6	7.2 (36.0) ^{ef}	8
ACSAD 176 (84)	6	6.6 (33.0) ^f	9
LSD (0.05)		3.3	

a,b,c,d,e,f: Means with different letters in a column differ significantly at $P < 0.05$

Rumen degradability of DM

Rumen DM degradability results have not revealed any significant differences among varieties (Table 3). Still, the extent of DM digestion over a 72 hours of incubation has varied between 55 and 65%. These results are well above the 40 to 50% usually reported in the literature. This could be due to the relatively high concentration of nitrogen and low concentration of fiber. The rate of DM digestion has, however, more than doubled between the slow degrading and the fast degrading varieties.

Conclusions

Results of the above studies have shown significant differences among barley varieties for their straw chemical composition, palatability for sheep, and DM rate of degradability in the rumen. These criteria could be strong arguments to include straw quality as a selection criterium in the cereal breeding program. Overall, while the old six-rows varieties have concentrations high in N and low in fiber, they are having lower DM digestibility and medium palatability. The newer ones have intermediate values for chemical composition and digestibility, but they are low in palatability. The two-rows varieties have lower nutritive value as determined by chemical composition, appropriate digestibility and relatively higher palatability level. Because variation among varieties in straw chemical composition is not big, intake becomes the most limiting factor in its feeding value. In this case, palatability would have a higher weight as a selection criterium.

Table 3. Rumen degradability parameters of barley straw

Variety (year inscription in catalogue)	Degradability parameters			
	Rate of degradation (h ⁻¹)	Degradability (%)	Lag time (h)	r ¹
Aglou (88)	0.026 ^c	56.99 ^a	0.92	0.92
Annaceur (91)	0.031 ^c	59.17 ^a	2.92	0.95
Arig 8 (73)	0.048 ^b	54.95 ^a	0.05	0.83
Rabat 071 (56)	0.031 ^c	55.46 ^a	0.86	0.95
Merzaga 077 (56)	0.026 ^c	56.46 ^a	1.10	0.92
ACSAD 176 (84)	0.028 ^c	54.76 ^a	0.90	0.98
ACSAD 60 (84)	0.061 ^a	65.15 ^a	2.35	0.99
INRA 1758	0.052 ^{ab}	64.65 ^a	2.93	0.99
Azilal (89)	0.065 ^a	55.69 ^a	9.95	0.93
SE	0.005	4.83		

r¹: Coefficient of correlation

a,b,c: Means with different letters in a column differ significantly at P<0.05

References

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