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Certain sorghum populations and cultivars' feed quality

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ABSTRACT

feed quality of different cultivars and populations of sorghum Through two trials, this study sought to describe some local people as well as those from ACSAD. The people of Sudan are seen to be superior than those in the other two localities. One provides a green and dry yield of 5311.47 g/m² and 497.2 g/m², respectively, with an average height of 55.07 cm and an average number of tillers per square meter of 128/m². There was no discernible variation in the chemical makeup of the hard grain and pasty milky phases in the second test. CP (6.66% and 6.1%) was almost same. From the milky-pasty stage to the hard grain stage, the cellulose rate of the Masser 17, Ezzera, and Biofuel types decreases. Their diameters range from 71 cm to 1.26 m, and the seed reaches maturity between 82 and 92 days after seeding. Milky-pasty populations have an average cellulose content of 26.08%, whereas hard-grain populations have an average cellulose content of 28.44%. Two groups—Kherssi, Beida Adrar, Tougourte, and Ain Sallah—have been formed by the study of the main components at the hard grain stage. Biofuel, Masser17, El Menea, Ezzera. The chemical composition of the stems varied more than that of the more digested leaves.

Keywords: Biometrics, chemical composition, sorghum

INTRODUCTION

41.57 million hectares are used for sorghum agriculture, including in the temperate and tropical regions where it is native (FAO 2001). After barley, maize, rice, and wheat, sorghum comes in fifth place among cereals. However, in Africa, where output exceeds 18.78 million tons, it is second only to maize (Chantereau et al. 1997). Nigeria (7.71 million tons) and Sudan (more than 2.49 million tons) are the continent's top producers. Of the 11.43 million tons of grain produced in Asia, 7.42 million tons are produced in India. With 13.61 million tons, the US is the world's top producer (FAO 2001). Grain sorghum is only used as animal feed in the US and other affluent nations. With the rise of tannin-free varietals and hence higher food value, it has seen a resurgence in popularity. Sorghum fiber for paper mills and sweet sorghums for the manufacture of biofuel are two new industrial potential (Chantereau et al. 1997).Holcus sorghum, Holcus saccaratus, and Holcus bicolor are the three species of cultivated sorghum that Linnaeus described in Species Plantanum in 1753. Person proposed calling Holcus sorghum (L) Sorghum in 1805. The current name for farmed sorghum is Sorghum bicolor (L.) Moench, which Clayton suggested in 1961 (FAO 1995). In Algeria, sorghum agriculture has taken up a substantial amount of space. The locals significantly relied on grain sorghum to combat starvation in the midst of this century (1943–1947). These types of Kabylian white sorghum belong to the loose-tailed sorghum (Sorghum vulgare L. var.effusus Korn.) group, which also includes sweet sorghum (Sorghum vulgare var.saccharatus L.) and broom (Sorghum vulgare var technicus Korn.). During Algeria's colonial era, both were badly grown; the first was for its tassel, while the second was for its stalks and leaves, which make a great feed after silage. Along with the aforementioned types, Trabut brought Sudanese sorghum, often known as sorghum menu (Sorghum exiguum Forsk.), to Algeria (INRAA 2006). Sorghum, often known as Sudan grass, has fine leaves and stalks. The word "cane" comes from the large stems and wide leaves of the sweet sorghum family. Depending on whether trait—Sudan grass or sweet sorghum—dominates in the hybridization, the hybrids (Sudan grass x sweet sorghums) vary somewhat (Grenet et Cie, ND). Sudan grass's thin stalks make it suitable for a variety of applications, including silage, tedding (after a day of pre-wilting), and green. The sweet sorghum, which is known as "cane" because to its large stems, is significant when sugar is present. There is a wide range of precocity. Thus, silage and consumption in green at the barn are two crucial professions (Grenet et Cie, ND). Laument said in 1948 that if neither maize nor irrigated sweet sorghum could be grown on fresh land (sorghum menu), then forage sorghum would be of considerable importance. Irrigated crops with strong simultaneous yields in grain and hardwood stems may affect both sweet and sweet sorghums. When the grains start to form, the mowing is done (before the possibility of an accident by hydrocyanic acid). Sorghum produces a lot of biomass and is a great intercropping in poor soil where corn does not grow well (Borghi et al., 2013). Originating in Egyptian Sudan, Sorghum sudanense is mostly used as a pasture crop (also known as Sudan-grass in the United States). It has a little hazy glabrous beneath the nodes and is between 2 and 3 meters long (Maire et al. 1952). Utilizing sorghum autogamy, a few short-cut, mechanically harvested lines swiftly overran the vast plains of the central and southern Midwestern states of the United States. Hybrids later took the place of these lineages (Chantereau et al. 1997). This increased the sorghum matter's digestibility, which helps animals that eat dual-use sorghum (Sorghum bicolor L. Moench) be more productive (Vietor et al. 2010). Among the 117 variants, the farmers' names for the five Ethiopian native varieties are in line with the Modeclus Cluster Analysis and the Canonical Discriminant Analysis Study (CDA). They did, in fact, establish several groupings. The farmers named these regional varieties of sorghum using morphological characteristics such as the color of the median vein, the color of the grains, the size of the grains, the color of the glume, the hairiness of the glume, and the shape of the grains. These regional types must be preserved. In this work, we have determined the chemical composition of the same populations at two different stages: milky-pasty and hard grains of the whole plant, as well as organs leaves and stems separately. The biometric parameters are determined from local populations and from the ACSAD (Arab Center for the Studies of Arid Zones and Dry Lands, Syria) variety.

MATERIALS AND METHOD

The plant material

The local seed was collected in 2012 from farmers in Algeria (Adrar wilaya) located 1330 km south of the capital. The first test was installed on 30/06/2013 at a dose of 3 seeds per pouch.

A second trial was conducted in 2015, with the introduction of eight ACSAD seed varieties (Syria). The origin, color, and weight of 1000 seeds of these populations are shown in Table 1.

The site and experimental device

The experimental device is composed of a completely random block type with three repetitions covering an area of 640,5 m². Seeding took place in open fields in a greenhouse covered by a net, at the Baraki experimental station of the National Institute of Agronomic Research of Algeria (INRAA). Located in Algeria, whose geographical coordinates are: 36 ° 41'4,35"Nord and at 3 ° 06'24,84"Est and an altitude of 18,5m. The seedling dose was 3 grams per bag. Fifteen days after germination, we left one plant per pouch. The first mowing was done 52 days after planting at the vegetative stage at an average of 40 cm.

Year Months	Precipitation (mm) Amount	Temperature (°C) Average	humidity (%) Average
2015-05	14	19.9	69.3
2015-06	14.4	23	70
2015-07	13.2	27.2	70.4
2015-08	7.2	27.3	70.9
2015-09	12.4	24	67.8
2015-10	91.6	20.6	74.5
2015-11	92.4	14.7	82
2015-12	245.20	22.39	72.13

The climate and irrigation

The area has a Mediterranean-style climate. Being in the subhumid bioclimatic stage, it is distinguished by a bright summer and a rainy season that typically lasts from September to May (Seltzer 1949). During the first week of the test, the mean and maximum temperatures were 15 °C and 23.3 °C, respectively. October saw the highest rainfall of 16 mm throughout the trial of rain fell at the climatic station throughout the course of the trial. During the trial period, the highest reported rainfall was 91.6 mm in October and 92.4 mm in November (Table 2). Over the course of the seven-month experiment, the average temperature was 22.39°C, the highest was 27.2°C in August, and the lowest was 19.9°C in April. With an average of 72.13%, the air's humidity was high throughout the trial. Twice a week at the start of vegetation and once a week at the conclusion of vegetation, irrigation water was provided to make up for the water shortage.

The soil

According to the physicochemical investigation, the soil has a basic pH of 7.87, a loamy clay structure (the triangle of soil structure), and an electrical conductivity of 0.28 d/m, indicating that it is not very salty. There is 0.034% nitrogen present. However, the potassium level is high at 0.67 meq/g and the phosphorus value is quite high at 53.15 ppm.

Table1. Origins, color, and weight of 1000 seeds of studied populations

Populations	Colors	Origins	Weight 1000 seeds
Hamra	Red	Algeria	40.16
Beïda	White	Algeria	31.13
Biofuel	White	ACSAD	40.4
Insallah	White	Algria	39.3
Ezraa	White	ACSAD	36.8
Tougourte	Black	Algeria	31.4
Masser 17	White	ACSAD	34.6
El Ménea	Black	Algeria	42.4
Dorado9	White	ACSAD	37.5
Kharsi	Red	Algeria	47

Table 2. Climatic data of the period of the test

RESULTS AND DISCUSSION

The Sudan population outperforms the other two groups according to every forage yield metric in Table 3. In fact, this one yields 5311.47 and 497.2 green and dry yields, respectively, with an average height of 55.07 cm and an average number of tillers per square meter of 128/m². The chemical makeup of the three populations—Hamara, Sudan, and Beida Adrar—varies throughout the plant throughout the milky-pasty stage. The corresponding dry matter contents are 92.5%, 94.5%, and 94.85%. The mean for the leaf and stem organs individually is 93.95%, which is almost the same (Table 4). The leaves have the greatest average mineral content (10.56% DM), and their Hamra rate is higher than that of the other two groups. In the stems of the three populations, the average rate of mineral matter is 5.98 percent, which is not far from the average for the plants in the three populations (7.34%) (Table 4). The ash content is higher than the average for 194 Burkina Faso lineages' organs and straw; the straw provides 7% DM, the leaves 6.5% DM, and the stems 2.5% MS (Kondombo 2001). Ruminant animals' digestibility is determined by the two additional total nitrogen and crude cellulose antagonist criteria, which indicate a high average total leaf A very significant difference in the two parameters, DM and CF, is shown by the analysis of variance in the chemical composition of the plants in the three populations (Table 7). However, at the stem level, the chemical composition reveals a very substantial difference in CF and none in CF, as well as a considerable difference in DM and MM (Table 9). The analysis of variance at the leaf level is very highly significant for CP and CF and very significant for MS and MM (Table 11). Therefore, the moisture content and crude cellulose content of the whole plant are analyzed in order to compare the populations. We examined the CP and CF content of the leaves (the leaf to stem ratio) in order to compare the digestibility of the populations. In the whole plant of the three populations, there was a very strong negative association between CF and MM and a very strong positive correlation between CP and MM. Crude cellulose and CP have a strong negative connection (Table 8). The chemical characteristics of the leaves and stems did not correlate (Tables 10 and 12).

Table 3. Green and dry yield and average height and number of talle/m² of local populations

Populations	GM g/m²	DM g/m²	Height in cm	Number of tillers/m²
Hamra	2517,19	258,53	35,97	81,33
Beida Adrar	2707,2	315,73	31,03	98,67
Sudan	5311,47	497,2	55,07	128

nitrogen content of the three populations (11.73%) (Table 5) with a higher Hamra leaf (12.92). The stems of the three populations record an average of 4.95% whereas the whole plant at this stage offers an average in all three populations of 7.66%. Burkinabé lines offer lower rates: leaves between 4.3-7%, which stems between 2-5.6% straw between 2.8-5.7% dry matter (Kondombo 2001). In Tunisia, in the milky-pasty stage, the content was 5.2% (Znaidi et al. 2010).

The level of fiber is high in the Sudan population, either in the organs or the whole plant (Tables 4 and 5), even

Table 4. Chemical composition of the *sorghum* plant of 2013- 2014 at milky-pasty milk stage

though the population has fine stems and is therefore mainly intended for fodder production. Its pasty milky-pasty stage has 32.73% lower than the average gross yield at the same stage in Znaidi et al. (2010) 38.51%. The average of the plants of the three populations is 28.57% CF, the same average of the stems of the three populations 28.10% higher than the average of the leaves 24.85% (Table 5). The leaves of the Hamra offer a cellulose level of 23.31% lower than the rate of the other two populations.

The average leaf rate in the green of this population is 28.91% and a dry leaf-to-stem ratio of 0.38% slightly lower

Table 6. Prportion of leaves and stems in the plant population and the ratio of leaves to stems

Populations	In% of dry matter			
	DM%	**MM%**	**CP%**	**CF%**
Hamra	92.51	8.36	8.08	27.07
Sudane	94.49	6.10	7.001	32.73
Beida Adrar	94.85	7.55	7.91	25.92
Average	93.95	7.34	7.66	28.57

than the Beida Adrar population ratio of 0.42% (Table 6). The average ratio of Burkinabe lineages is 0.49, the minimum is 0.25 and the maximum is 0.8 (Kondombo 2001).

Populations	% of leaves in green	% of the stems in green	Report leaf on stems in sec
Hamra	28.91	69.42	0.38
Beida Adrar	35.32	78.037	0.42

Table 5. Chemical composition of stems and leaves of *sorghum* of companion 2013/2014 at milky-paste stage

Populations	Rods				Leaves			
	DM%	**MM %DM**	**CP %DM**	**CF %DM**	**DM%**	**MM %DM**	**CP %DM**	**CF %DM**
Sudan	93.74	6.29	5.28	31.16	92.89	10.50	10.93	26.57
Beida Adrar	93.36	5.63	4.70	26.38	93.36	9.67	11.35	24.67
Hamra	93.32	6.03	4.88	26.77	92.97	11.51	12.92	23.31
Average	93.47	5.98	4.95	.10	93.08	10.56	11.73	24.85

Table 12. Correlation matrix of the chemical parameters of the leaves of the three local populations in the milky-pasty stage

	Variance	**DDL**	**Chi2**	**P**	**Meaning**		**MS%**	**MM%**	**MAT%**	**CB%**
MS%	3.507	8	28. 056	0.0009	***	MS%	1			
MM%	1.360	8	10.883	0.4169	NM	MM%	-0. 182	1		
MAT%	0.702	8	5.613	0.6191	NM	MAT%	0.385	0.131	1	
CB%	16.761	8	134.091	0<0.0001	***	CB%	0.005	0.375	-0.191	1

NM: no significant ; *: significant; ***: very highly significant

Table 8. Correlation matrix of the chemical parameters of the plants of the three local populations at the milky-pasty stage

	MS%	**MM%**	**MAT%**	**CB%**
MS%	1			
MM%	-0. 164	1		
MAT%	-0.280	0.826	1	
CB%	-0.243	0.882	-0.744	1

DDl = 9-2 = 7 α = 0.1 rth = 0.58 (*). α = 0.05 rth = 0.66 (**). α = 0.01 rth = 0.79 (***)

Table 9. Analysis of the variance of the chemical parameters of the stems of the three local populations at the milky-pasty stage

	Variance	**DDL**	**Chi2**	**P**	**Meaning**
MS%	0.249	8	1.994	0.0376	*
MM%	0.260	8	2.044	0.0429	*
MAT%	0.404	8	3.229	0.1617	NM
CB%	22.430	8	179.442	0<0.0001	***

NM: no significant ; *: significant; ***: very highly significant

Table 10. Correlation matrix of the chemical parameters of the stems of the three local populations at the milky-pasty stage

	MS%	MM%	MAT%	CB%
MS%	1			
MM%	-0. 512	1		
MAT%	0.012	-0.131	1	
CB%	-0.404	0.394	0.429	1

Dd1 = 9-2 = 7 α = 0.1 rth = 0.58 (*). α = 0.05 rth = 0.66 (**). α = 0.01 rth = 0.79 (***)

Table 11. Analysis of the variance of the chemical parameters of the leaves of the three local populations in the milky-pasty stage

	Variance	DDL	Chi2	P	Meaning
MS%	0.118	8	0.948	0.0029	**
MM%	3.259	8	26.070	0.0020	**
CB%	4.276	8	34.209	0<0.0001	***

*: significant; ** : very significant. ***: very highly significant

Dd1 = 9-2 = 7 α = 0.1 rth = 0.58 (*), α = 0.05 rth = 0.66 (**), α = 0.01 rth = 0.79 (***)

Along with the three populations from the first experiment, we also included 10 local populations and varieties (ACSAD) in the second study of 2014/2015. The milky-pasty stage and the hard grains stage were the two physiological phases that needed to be examined. There was little variation between these two phases' chemical compositions. With a little rise in the other chemical characteristics of the milky-pasty stage in the hard grain stage, the average level of CP was really about the same at both phases (6.656% and 6.089%) (Table 13). Furthermore, this process was not followed by all populations and kinds. The cellulose content of the milky-pasty stage cultivars Masser 17, Ezzera, and Biofuel started to decline during the hard grain stage (Table 13). At the hard-grain stage, parenchymal tissues were synthesized at the core level of the stem, which may be explained by the reduction in the bark-to-marrow ratio of their stems (Table 14). These types are also distinguished by their small size and brief cycle. The seeds range in size from 71 cm to 1.26 m, and they achieve maturity 82 to 92 days after planting (Table 14). In comparison to the values provided by the Jarrige tables (1988) at the milky-pasty stage, the average cellulose content of milky-pasty populations was 26.08% and the hard-grain stage was 28.44% (Table 14). 6.9% CP and 30.7% CF.According to the analysis of variance, there is a very significant difference between the CP and CF variables and a very significant difference across populations and varieties for the DM parameter (Table 15). Milky-pasty DM has a very strong negative correlation with CP and a strong positive correlation with MM and CB, as Table 16 demonstrates. There is a strong correlation between the two chemical parameters, MM and CF. Table 17 demonstrates a very strong negative association between CF and CP and a very high positive hard grain stage between MM and CF. There is a strong positive association between MM and DM. El Menea, Biofuel, and Ezzera have the lowest mineral needs in the milky-pasty stage, whereas the Tougourte population has the greatest average level (Figure 1). In contrast, El Menea, Tougourte, Kharssi, and Beida Adrar have significant demands during the hard grain stage. The first two populations are hybrids that are simple to fade select for fodder production because they have fine stems that are less than 2 mm and a high height of around 1.5 m (Table 14). Biofuel has the least amount of MM required (Figure 2). The stage with the greatest CP concentration was examined. was found in the Biofuel type (9.1%) at the milky-

7.03% in the hard grains stage and 7.03% at the pasty stage (Figures 3-4, Table 13). At the milky-pasty stage, Ain sallah had the lowest, followed by Kherssi at the hard grain stage. At the level of oases and dry zones, these two populations are mostly used for seed production. The Ain sallah population has larger, higher stems (1.72 cm), wide leaves, a lengthy cycle (128.5 days), and huge, compact panicles. The plant may be harvested and used as a source of nitrogen for animal feed.

concentrate. The population Kherssi, is shorter than Ain Sallah, but richer in nitrogen at the milky-pasty stage, at the hard grain stage it produces vegetables, but it is characterized by the presence of the pigments that oasis women use as dyeing.

In the milky-pasty stage (Figure 5), the highest crude fiber content is found in the Tougourte population and the lowest in the El Menéa population respectively 30.59%, 21.57% (Table 13). 30% of content is good (Jarrige 1988, 1995).

Table 13. Chemical composition of ten populations and varieties of sorghum at milky-pasty and hard grain stages

Populations and varieties	Milky-pasty stage in %DM				Hard grain stage in %DM			
	DM%	**MM %**	**CP%**	**CF %**	**DM%**	**MM%**	**CP%**	**CF**
AinSallah	93.751	6.978	4.133	27.67	94.476	7.776	4.712	32.07
Khersi	93.575	7.245	8.121	26.28	92.738	8.930	3.886	32.69
Masser17	93.400	7.135	8.652	27.38	94.437	8.143	7.113	24.53
Ezzera	92.696	6.264	8.583	23.62	94.310	7.906	7.576	21.78
Tougourte	93.974	8.868	6.289	30.59	94.475	9.019	4.956	32.90
Biofiuel	92.904	6.692	9.089	24.67	94.759	7.641	7.027	21.39
El Menea	93.474	6.094	6.085	21.57	94.626	9.341	8.082	32.33
Beida Adrar	93.190	7.131	5.563	26.43	94.511	8.288	5.357	29.88
Dorado9	94.638	7.178	3.388	26.52	-	-	-	-
Average	93.511	7.065	6.656	26.08	94.291	8.381	6.089	28.444

Table 14. Biometric parameters of ten populations and varieties of sorghum at milky-pasty and hard grain stages

Populations and varieties	Milky-pasty stage					Hard grain stage	
	Cycle (day)	**Height (cm or m)**	**Diameter of stems(mm or cm)**	**Bark /Moelle ratio (sec.)**	**The report sheets/stems**	**Cycle (day)**	**Bark/Moelle ratio (sec.)**
In Sallah	60	1.4667m	1.72 cm	2.84	0.29	128.5	1.560
Khersi	35	1.2975m	12.35mm	2.50	0.5	111.33	4.125
Masser17	35	1.2225m	11.275mm	3.92	0.24	92.33	2.800
Ezzera	35	1.2575m	10.385mm	3.63	0.23	85.33	2.475
Tougourte	39	1.43m	1.77mm	3.75	0.30	106	1.980
Biofuel	35	70.67cm	18.63mm	2.53	-	82	2.270
El Ménéa	60	1.5367m	1.525mm	5.25	0.2	105.67	3.33
Beida Adrar	35	1.3525m	17.2mm	3.13	0.3	81	1.60
Dorado 9	60	96.33cm	2.22mm	2.95	0.4	106	2.32
Hamra	-	-	-	-	-	115	1.48

Table 15. Variance analysis of the ten milky-pasty populations and varieties of *sorghum*

	Variance	**DDL**	**Chi2**	**P**	**Meaning**
MS%	0.373	26	9.701	0.0031	**
MM%	0.675	26	17.557	0.2174	NM
MAT%	4.491	26	116.459	0<0.0001	***
CB%	8.527	26	221.706	0<0.0001	***

NM: no significant; **: very significant. ***: very highly significant

Table 16. Correlation matrix of the ten milky-pasty populations and varieties of *sorghum*

Table 17. Correlation matrix of ten populations and varieties of hard grain *sorghum*

	DM%	**MM%**	**CP%**	**CF%**		**DM%**	**MM%**	**CP%**	**CF%**
DM%	1				DM%	1			
MM%	0.428**	1			MM%	0.467**	1		
CP%	-0.658***	-0.085	1		CP%	0.198	-0.157	1	
CF%	0.358**	0.721***	-0.179		CF%	0.110	0.523***	-0.542***	1

Ddl=15-2=25 α=0.1 rth=0.323 (*) , α=0.05 rth=0.381 (**),
α=0.01 rth=0.487(***)
Ddl=24-2=22 α=0.1 rth=0.344 (*) , α=0.05 rth=0.404 (**),
α=0.01 rth=0.515(***)

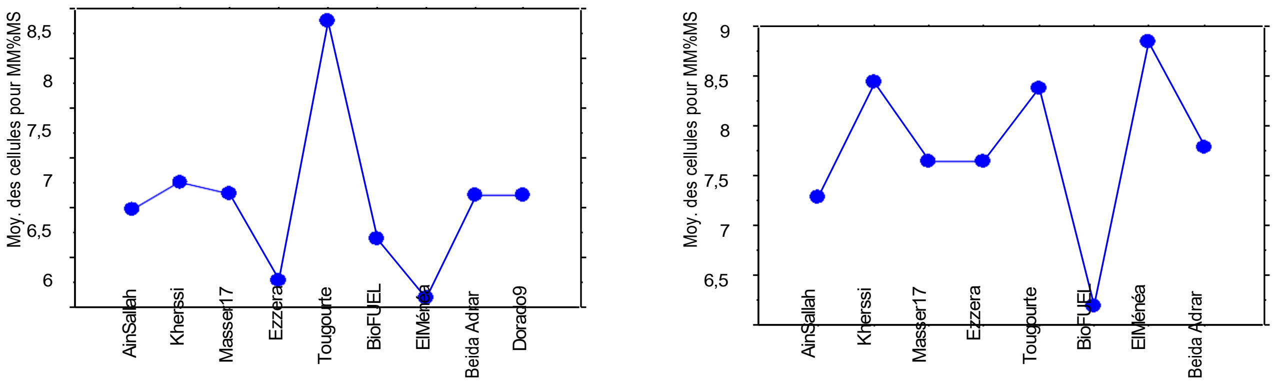


Figure 1. The average content of MM populations and varieties at milky-pasty stage

Figure 6 shows that the populations Ain Sallah, Kherssi, El Menea, and Tougourte had significant quantities of crude cellulose at the hard grain stage, but they did not surpass 33%. A lengthy cycle of more than 100 days and a high to medium height are characteristics of all these populations; this fiber rate is required to withstand the weight and lodging of the panicles. Four axes may be selected in the examination of the main components at the milky-pasty stage based on the Kaiser criteria (Figure 7). The first axis of the elbow criteria shows a significant decrease (from 42.3% to 6.01% of the inertia). With the exception of the parameter height, which tends to cancel itself out as it gets closer to the center, all of the parameters in the foreground (Figure 8) are near the circle, indicating that they are in fact closely linked with the two elements that make up this plane (F1 and F2). When the greatest of the original dispersion of the cloud's points is projected, the first factorial axis (1x2) yields (42,3% + 28,37% = 70,67%), the axis that is maintained. Every variable is contained inside a certain region of the correlation circle. The two variables have a maximum angle of less than 90 °. This implies that there is a positive correlation between all of the variables.El Menea, Tougourte, Dorado9, Ain Sallah, and other populations and varieties are included in the same plane as the parameters, cycle in the day, MS%, ratio of bark on the marrow, MM%, CF%, and stem height. The criteria CP% and stem diameter group the remaining populations, which include Ezzera, Biofuel, Masser17, Beida Adrar, and Kherssi, on the opposite plane. The Kaiser Criterion (Figure 9) may maintain three axes at the hard grain stage. There is a notable decrease from the first axis in the elbow criteria (from 46.68% to 20.96% of the inertia). All of the values in the foreground (Figure 10) are near the circle, indicating a strong correlation between them and the two components (F1 and F2) that make up this plane. According to the first factorial axis (1x2), 46.68% plus The axis that is maintained by the projection of the greatest of the initial dispersion of the cloud's points is 27.9% = 74.58%. Every variable is contained inside a certain region of the correlation circle. Less than 90° is the greatest angle that may exist between the two variables. This implies that there is a positive correlation between all of the variables. Populations and varieties, including Kherssi, Beida Adrar, Tougourte, and Ain Sallah, are included in the same plan as the parameters, cycle of the day, ratio of bark on the marrow, MM%, and CF%. The metrics CP% and DM%, which group the remaining populations—Ezzera, Biofuel, Masser17, and El Menea—occupy the opposite plane. The chemical makeup of the stems varied more than that of the leaves, according to the findings. Compared to the other factors, this diversity is much higher with the total walls. Compared to stems and entire straw, leaves have a lower average total wall (CF) content. The reason for this difference is because whereas the stems are rich in fibrous and poorly digested support tissues, the leaves are richer in chlorophyllin parenchyma (hemicelluloses), which are more digestible walls. Additionally, the cellulose rate of the Masser 17, Ezzera, and Biofuel types decreased from the milky-pasty stage to the hard grain stage. This may be explained by the fact that their stems' bark-to-marrow ratio has decreased, resulting in the synthesis of parenchymal tissues at the stem's core level during the hard grain stage. These types are also distinguished by their small size and brief cycle. However, the wall rate rises for other populations (short and long cycles). Kondombo (2001), who observed that the wall contents are greater in the early lines than in the latter ones, came to the same conclusion. As a result, the authors who claim that the chemical composition, particularly the cellulose content, changes after the heading stage (Andrieu and Weiss 1981, Demarquilly and Andreieu 1987) do not apply to all populations.

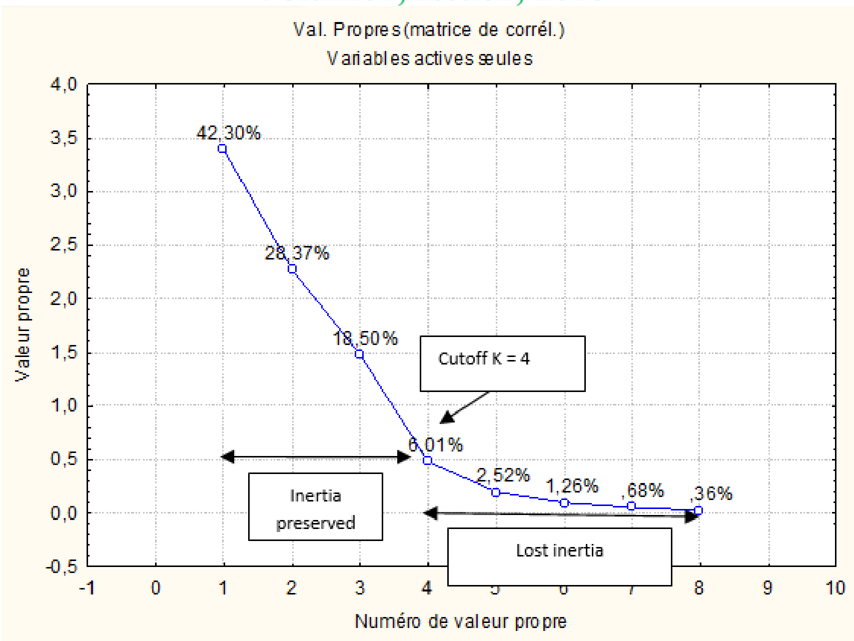


Figure 7. Graphical presentation of eigenvalues according to the Kaiser Criterion milky-pasty stage

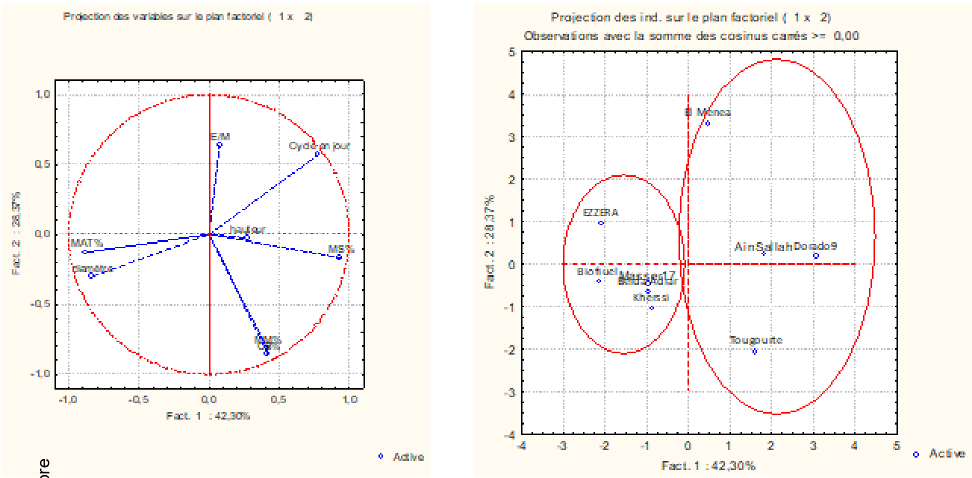
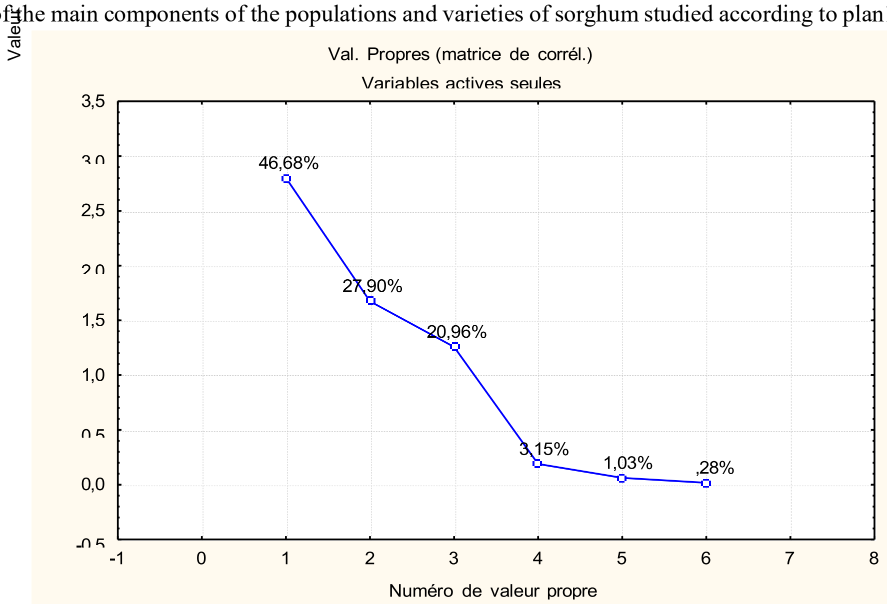


Figure 8. Analysis of the main components of the populations and varieties of sorghum studied according to plan1 at the milky-pasty stage



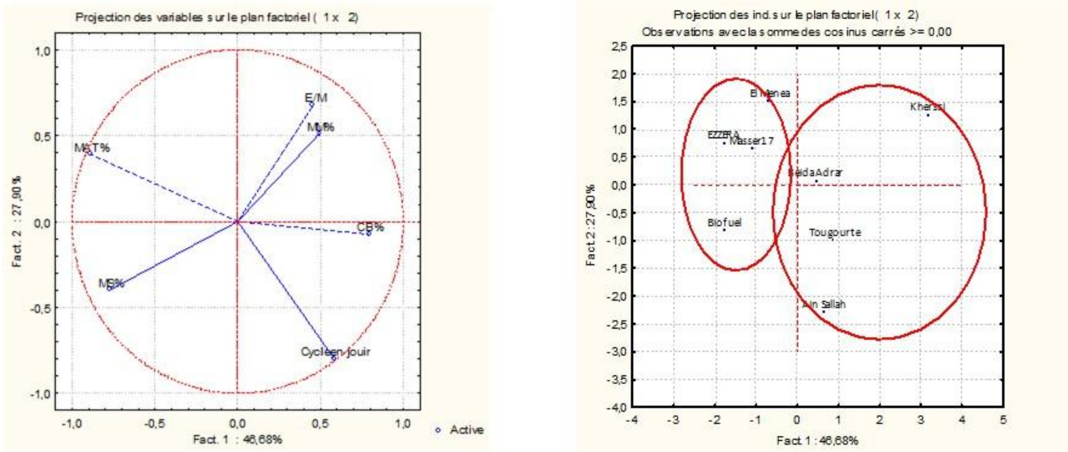


Figure 10. Analysis of the main components of the populations and varieties of *sorghum* studied according to plan1 at the hard grain stage

In this test, the average total nitrogenous matter (TMA) and total mineral contents are on average higher in the leaves than in the whole stems and straws. As for the whole straw, the different contents of the chemical composition and the values of digestibility, follow the evolution of those of the stems, because of their greater contribution to the total dry matter.

For the foraging aspect of the study, the analysis of the result leaves, stems, and straws whole, allowed to highlight the relations that exist between the main constituents and their influence on the food value of the straws. This analysis showed that many characters segregate independently. The use of fodder by animals is faced with the sorting problem, explaining that often the ingested values are higher than those distributed. The best populations and varieties for the content of CP, were: Khersi, Masser17, Ezzera, Biofuel at the milky-pasty stage. With El Menea, Ezzera, Biofuel, and Maser17 at the hard grain stage being the best for the content of CP. The low levels of cellulose in the milky-pasty stage are present in El Menea, Ezzera, and Biofuel whereas at the hard grain stage the low levels are at Biofuel, Ezzera, and Masser17.

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