Field performance and nutritive value of a new forage sorghum variety "Pnina" recently developed in Israel

Carmi A.[1], N. Umiel[2], A. Hagiladi[2], E. Yosef[3], D. Ben-Ghedalia[3] and J. Miron[3] -*

[1]Institute of field and Garden Crops, [2]Institute of Horticulture and [3]Institute of Animal Science, ARO; The Volcani Center, P.O Box 6, Bet-Dagan, 50250, Israel

Introduction:

Water deficiency and high water price recently led in Israel to expansion of using Sorghum for feeding dairy-cattle. The main problems in raising the commercial cultivars of forage Sorghum are: first – high lodging causing considerable loses of yield, second – low content of dry matter that makes it difficult to prepare high quality silage. The objective of this study was to examine the field performance of a new variety of sorghum entitled "Pnina" which was recently bred in Israel and to evaluate the chemical composition and in vitro digestibility of its silage. The "Pnina" variety was compared with the widely used sorghum forage variety FS-5 and a Brown Mid-Rid (BMR) sorghum/sudan hybrid Nutriplus.

Materials and Methods:

The local climate in this region of Mediterranean lacks any summer rainfall. The field was in fallow during the winter, before the sorghum season, and received 700 mm of rainfall. The field was tilled to the depth of 15 cm, and was pre-sowing treated with Atrazine. Nitrogen fertilization of 160 kilograms per hectare was given before emergence. The sorghum was sown at a density of 250,000 seeds per hectare. The distance between adjacent rows was 45 cm. The plants were sown on May 11 2003, and irrigated with a total of 190 mm non-salty recycled water through sprinklers. Plants were sampled and yields were measured at hard dough stages of maturity. Nutriplus and FS-5 reached this stage on 15/8, whereas Pnina plots were sampled at 28/8. Each sampling included harvesting of two adjacent rows, 5 m length, from each of the four plots (replicates) of the three sorghum varieties.

RESULTS AND DISCUTION:

The tall cultivars FS-5 and Nutriplus (average heights of 235 and 280 cm, respectively) suffered in hard dough stage from lodging rates of 46% and 73%, respectively. Pnina showed a semi-dwarf height (135 cm) and was absolutely resistant to lodging in each of its harvest stages.

Pnina plants were more leafy with higher dry weight ratio of leaves to stems (0.79), as compared with Nutriplus and FS-5 (0.34 and 0.36, respectively). Dry matter (DM) content of less than 26% might lead to drainage and to silage spoiling in the silo. The DM content of FS-5 and Nutriplus plants was below this minimal level at early milk stage and was elevated slightly at the hard dough stage to 26.4 and 27.1%, respectively. Notwithstanding, Pnina plants contained 27% DM in early milk stage and 36.9% DM in hard dough stage. Crop yields of the three varieties harvested in hard dough stage, were similar and ranged between 13.3 to 14.7 tons DM per hectare.

Dry matter losses during ensilage were similar in the three varieties harvested at hard dough stage. In vitro DM digestibility of hard-dough silages of the three varieties ranged between 62.5 and 67.1%, with FS-5 having the highest digestibility. Neutral detergent fiber (NDF) content was higher in Pnina silages. Yields of digestible silage per hectare, were similar in the three varieties when harvested at hard-dough stage (8.4 to 8.8 tons DM per hectare), however, yield of digestible NDF per hectare was significantly higher in Pnina.

Table 1. Morphological characteristics, extent of lodging, and dry matter (DM) partitioning of plant fractions in three sorghum varieties .

Hard dough stage						
Variety	Plant height (cm)	Leaf number on axis	Lodging extent (%)	Fractions partitioning (% of DM yield)		
				Leaves	Stems	Heads
Pnina	129 ^{c}	14.0 ^{a}	0 ^{c}	24.5 ^{a}	31.0 ^{c}	44.5 ^{a}
Nutriplus	260 ^{a}	10.0 ^{b}	73.4 ^{a}	16.2 ^{b}	46.9 ^{b}	36.9 ^{b}
FS-5	198 ^{b}	8.3 ^{b}	46.6 ^{b}	20.1 ^{a}	56.0 ^{a}	23.9 ^{c}
SEM	10.0	0.77	7.60	1.35	1.64	2.17

^{a,b,c} means in the same column and maturity stage followed by different superscripts differ significantly at P< 0.05. SEM = standard error of the means.

Table 2. Yield and content of dry matter (DM), neutral detergent fiber (NDF) and water soluble carbohydrate (WSC), in three forage sorghum cultivars.

Hard dough stage					
Variety	Yield (Ton /Hectare)		Content (% of DM)		
	DM	NDF	DM (%)	NDF	WSC
Pnina	14.57	9.40 ^{a}	36.9 ^{a}	64.5 ^{a}	0.36 ^{c}
Nutriplus	14.70	8.31 ^{a,b}	27.1 ^{b}	56.5 ^{b}	14.0 ^{a}
FS-5	13.34	6.94 ^{b}	26.4 ^{b}	52.0 ^{b}	11.0 ^{b}
SEM	0.57	0.39	0.36	0.69	0.35

^{a,b,c} means in the same column and maturity stage followed by different superscripts differ significantly at P< 0.05. SEM = standard error of the means.

Table 3. Losses during ensilage of dry matter (DM) and water soluble carbohydrate (WSC), silage pH and silage protein content of three sorghum cultivars harvested at Hard dough stage.

Silage parameter/ variety	Pnina	Nutriplus	FS-5	SEM
WSC loss during ensilage (%)	100.0^{a}	92.2^{ab}	84.1^{b}	3.71
Residual WSC (% of DM)	0	1.12	1.92	0.50
DM loss during ensilage (%)	3.83	2.53	6.40	1.07
Silage DM yield (Ton / Hectare)	14.02	14.33	12.50	0.65
Silage pH	4.45^{a}	3.74^{b}	3.68^{b}	0.03
Protein (% of DM)	7.61	7.01	7.26	0.20

^{a,b,c} means in the same raw followed by different superscripts differ significantly at P< 0.05; SEM = standard error of the means.

Table 4. Silage composition and in vitro digestibility of three sorghum cultivars harvested at Hard dough stage.

Silage component / variety	Pnina	Nutriplus	FS-5	SEM
NDF (% of DM)	61.9^{a}	56.9^{b}	52.7^{c}	1.17
Hemicellulose (% of DM)	28.8	24.5	24.3	1.38
Cellulose (% of DM)	27.1^{a}	26.2^{ab}	24.8^{b}	0.60
Lignin (% of DM)	6.01^{a}	6.30^{a}	3.60^{b}	0.16
DM Digestibility (%)	62.5^{b}	61.6^{b}	67.1^{a}	0.93
NDF Digestibility (%)	56.1^{ab}	48.7^{b}	61.3^{a}	1.76
Yield of digestible silage DM (Ton/Hectare)	8.75	8.83	8.39	0.42
Yield of digestible silage NDF (Ton/Hectare)	4.87^{a}	3.97^{b}	4.04^{b}	0.28

^{a,b,c} means in the same raw followed by different superscripts differ significantly at P< 0.05; SEM = standard error of the means.

Corresponding author :
E. Mail: Carmi@volcani.agri.gov.il