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# Comparative Studies on the Growth, Forage Yield and Quality of Sorgum (Sorghum Bicolor l.) Varieties under Irrigated Conditions of Faisalabad

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## Abstract

**A field experiment to compare forage yield and quality of eight sorghum cultivars/genotypes namely JS-263, JS- 88, Hegari, F-9601, F-9603, F-9706, F-9806 and F-9809 was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during the year 2008. Significant differences were observed among the genotypes for forage yield and quality. The variety F-9603 produced significantly higher forage and dry matter yield due to greater plant density, plant height and thicker stem. Whereas, the variety Hegari proved to be better than other varieties regarding quality parameters. It produced maximum crude protein percentage (7.62%), total ash percentage (9.58%) and lowest crude fibre percentage (28.37 %). JS-88 produced the maximum ether extractable fat percentage (1.92 %). The genotype F-9603 proved better regarding yield but for quality it needs to be harvested earlier.**

**Key Words:** *Sorghum bicolor*, varieties, forage yield, crude protein and fibre.

## Introduction

Fodder crops play pivotal role in the agricultural economy of developing countries by providing cheapest source of feed for livestock. Livestock is a major sub-sector of agriculture in Pakistan and plays a key role in the economy of the country particularly in rural economy. Livestock contribute approximately 53.2 % of the agricultural value added and 11.4 % to the national GDP during 2009-2010. (GOP, 2010). In Punjab fodder crops are grown on an area of 2.7 million hectares, with annual forage production of 57 million tones, giving an average forage yield of 21.1 tones per hectare (Bhatti, 2001; Bilal *et al.,* 2001). Due to low yield $ha^{-1}$ and minimum area under fodder crops, the available fodder supply is 1/3 less than that actually needed and shortage is further being increased due to reduction in area under fodder crops by 2% after each decade (Sarwar *et al.,* 2002). Among the kharif forage crops, sorghum (*Sorghum bicolor L.*) is an important one that possesses a wide range of ecological adaptability because of its xerophytic characteristics. It is widely grown by the subsistence growers for feed and fodder in rainfed as well as in irrigated regions of Pakistan. Its fodder is fed to almost every class of livestock and can be used as hay or silage. However, sorghum fodder is poor in quality due to low protein content and presence of hydrocyanic acid (Hingra *et al*., 1995). The performance of dairy animals depends on the consistent availability of quality fodder in adequate amount. Therefore, the critical limitation on profitable animal production in developing countries is the inadequacy of quality forage (Sarwar *et al*., 2002). Among the many options to overcome the shortage of forage, the best one is the introduction of high yielding crop varieties (Bilal *et al*., 2001). Significant differences have been reported among the sorghum cultivars for yield, quality traits (Ashraf *et al*., 1995) and response to fertilizer application (Chandravanshi *et al*., 1973). Ayub *et al*. (1999) reported that cultivar Hegari gave significantly higher green fodder and dry matter yield due to greater plant height, stem diameter and leaf area per plant. There is a dire need to develop such cultivars which have higher yield potential so that growing demand of forage for livestock can be fulfilled (Chohan *et al*., 2006).The present study was therefore, designed to find out the most suitable sorghum cultivar regarding forage yield and quality.

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## Materials and Methods

A field experiment to compare forage yield and quality of sorghum cultivars i.e. JS-263, JS- 88, Hegari, F-9601, F-9603, F-9706, F-9806 and F-9809 was conducted at the Agronomic Research Area, University of Agriculture, Faisalabad during the years 2007-2008, on a medium loam soil. The experiment was laid out in randomized complete block design (RCBD) with three replications,

measuring a net plot size of 3m x 9.5m. The crop was sown with single row hand drill on well prepared seed bed in 30 cm apart rows on May 30, 2008. A basal dose of 75 kg N and 60 kg $P_2O_5$ $ha^{-1}$ was applied at the time of seed bed preparation in the form of Urea and SSP, respectively. All other agronomic practices were kept normal and uniform in all treatments. The crop was harvested on August 13, 2008. Ten plants were randomly selected from each plot for individual plant observations. Plant height was measured from soil level up to the highest leaf tip with a measuring tap. Stem diameter was measured with the help of vernier caliper from the base, middle and top portions and then their averages were taken. Leaf area was measured with the help of electronic leaf area meter model LI-3000. Known weight of chopped green forage was dried at 80 $^0$C in an oven to a constant weight for determination of dry matter percentage. Quality parameters like crude protein, crude fibre, ether extractable fat and total ash % were determined as described by AOAC (1984). The collected data was analyzed statistically using Fisher's analysis of variance technique and Duncan's multiple range (DMR) test at 5 % probability level was used to compare the difference among the treatment means (Steel *et al.,* 1997).

## Results and Discussion

### Yield and Yield Parameters

Plant density differed significantly among the sorghum cultivars and it ranged from 35.33 to 60.67 plants $m^{-2}$ (Table.1). Variety F-9603 produced significantly more number of plants per unit area than all other varieties. These significant differences may have been either due to differences in viability of seeds or differences in 1000- grain weight. These results differed from those of Mehmud *et al*. (2003) who reported similar plant density per unit area among sorghum cultivars. Data presented in the table-1 revealed that Variety F-9603 produced the tallest plants but did not differ significantly from varieties F-9601 and JS-263. The variety F-8909, producing the smallest plants and did not differ significantly from varieties JS-263, JS-88, Hegari and F-9806. Varieties JS-263, Hegari, F-9601 and F-9706 were also statistically at par with one another. The variation in plant height had been due to the difference in genetic make up of the varieties. The significant differences among the sorghum cultivars had also been reported by Chohan *et al*. (2003; 2006), Mehmud *et al*. (2003) and Yousef *et al*. (2009).The variety F-9603 produced thickest plants (1.42 cm), while plants with thinnest stem were recorded in variety F-9706 (0.87 cm). Varieties Hegari, F-9809 and JS-263 gave similar stem diameter. Variation in stem diameter might have been due to differences in the genetic make up of the varieties. Variation in stem diameter among the cultivars of sorghum has also been reported by Ayub *et al*. (1999) and Yousef *et al*. (2009).

The variety F-9603 produced the highest number of leaves per plant but did not differ significantly from varieties JS-88 and F-9809. The variety JS- 263 produced the lowest number of leaves per plant and remained statistically at par with varieties Hegari, F-9601, F-9806 and F-9809. These results are consistent with those of Chohan *et al*. (2006) and Yousef *et al*. (2009). Variety Hegari gave significantly higher leaf area per plant (2759.53 $cm^2$) than all other varieties and it was followed by JS-263, F-9603 and JS-88 having leaf 2371.93, 2305.50 and 2056.30 $cm^2$, respectively (Table.1). The minimum leaf area per plant (1470.90 $cm^2$) was recorded in variety F-9706 but it was statistically similar to cultivars F-9601, F-9806 and F-9809. The variation in leaf area per plant may due to differences in genetic make up of the cultivars. These results confirm the findings of Mehmud *et al*. (2003) and Chohan *et al*. (2006). The data presented in table.1 indicated that variety F-9603 gave significantly higher forage yield (47.84 t $ha^{-1}$) than all other varieties and it was followed by F-9601, F-9809 and F-9806, respectively. The minimum fodder yield (30.81 t $ha^{-1}$ ) was given by cultivar Hegari and it did not differ significantly from cultivars JS-263 and F-9706. The cultivar F-9603 gave higher fodder yield mainly due to greater leaf area per plant, stem diameter, plant density and plant height. Mehmud *et al*. (2003) and Chughtai *et al*. (2007) have reported significant differences for forage yield among sorghum genotypes.The variety F-9603 gave the highest dry matter yield (9.62 t $ha^{-1}$) but not differed significantly from varieties F-9601 and F-9809 and these both genotypes have average dry matter yields of 8.83 and 8.78 t $ha^{-1}$, respectively. Variety Hegari produced the lowest dry matter yield (6.20 t $ha^{-1}$) and it was statistically similar with variety JS-263. It is obvious that if there has been higher green fodder yield, there will be higher dry matter yield provided that there has not been a variation in dry matter percentage. Significant differences among the sorghum genotypes have been reported by Carmi *et al*. (2006) and Yousef *et al*. (2009).

### Quality Parameters

The data presented in table-1 revealed that variety F-9603 produced the highest crude fibre percentage (31.42 %) and it was followed by F-9601, JS-263 and JS-88 having crude fibre percentage 30.78, 30.50 and 30.19, respectively. The minimum crude fibre percentage (28.37%) was recorded in case of cultivar Hegari. These differences can be attributed to

**Table No. 1 Growth, yield and quality parameters of different sorghum cultivars**

| Varieties | Plant density ($m^{-2}$) | Plant height (cm) | Stem diameter (cm) | No. of Leaves Per Plant | Leaf area per plant ($m^2$) | Forage Yield (t $ha^{-1}$) | Dry Matter Yield (t $ha^{-1}$) | Crude Fibre (%) | Crude Protein (%) | Ether Extractable Fat (%) | Total ash (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| JS-263 | 42.67 b | 178.9 abc | 1.14 bc | 9.13 c | 2371.93 b | 32.80 c | 6.79 cd | 3.50 c | 5.71 d | 1.80 b | 8.76 d |
| JS-88 | 43.33 b | 169.4 c | 0.99 d | 10.40 b | 2056.30 c | 38.73 b | 7.98 b | 30.19 d | 6.50 c | 1.92 a | 8.23 f |
| Hegari | 37.33 b | 176.3 bc | 1.24 b | 9.83 bc | 2759.53 a | 30.81 c | 6.20 d | 28.37 h | 7.62 a | 1.58 e | 9.58 a |
| F-9601 | 45.67 b | 182.1 ab | 0.98 d | 9.87 bc | 1475.70 d | 41.81 b | 8.78 ab | 30.78 b | 5.72 d | 1.65 d | 9.03c |
| F-9603 | 60.67 a | 187.0 a | 1.42 a | 10.83 a | 2305.50 b | 47.84 a | 9.62 a | 31.42 a | 5.49 d | 1.73 c | 8.51 e |
| F-9706 | 35.33 b | 173.6 b | 0.87 e | 9.77 bc | 1470.90 d | 32.40 c | 7.79 bc | 29.00g | 7.04 b | 1.64 d | 9.31 b |
| F-9806 | 45.33 b | 169.4 c | 1.11 c | 9.20 c | 1498.20 d | 40.86 b | 8.07 b | 29.43 f | 6.81 bc | 1.80 b | 7.89 h |
| F-9809 | 43.33 b | 169.3 c | 1.22 b | 10.07 abc | 1671.93 d | 41.71 b | 8.83 ab | 29.91 e | 6.61 c | 1.91 a | 8.02 g |

differences in growth stage at harvest. Mehmud *et al*. (2003), (Almodares ,2009) and Tauqir *et al*. (2009) have also reported significant differences among sorghum cultivars for crude fibre contents. Hegari produced significantly higher crude protein contents (7.62%) than all other varieties (Table-1) and it was followed by F- 9706, F- 9806, F- 9809 and JS- 88 having crude protein contents of 7.04, 6.81, 6.61 and 6.50 percent, respectively. While the lowest protein percentage (5.49 %) was recorded in variety F-9603 which was statistically at par with JS- 263 and F-9601. Carmi *et al*. (2006), Miron *et al*. (2007) and Tauqir *et al*. (2009) have also reported significant differences among the sorghum genotypes for crude protein contents. The highest ether extractable fat percentage (1.92 %) was recorded in variety JS- 88 but it was statistically similar to F-9809 as shown in the table-2. The cultivar Hegari gave significantly lowest ether extractable fat percentage (1.58 %) than all other varieties. These differences can be attributed to differences in genetic traits of crop plants. The significant differences in ether extractable fat percentage among the sorghum cultivars have also been reported by Ayub *et al*. (2002). The data pertaining to ash percentage revealed that the variety Hegari gave significantly higher ash percentage (9.58 %) than all other varieties (Table-1). The minimum ash contents (8.02 %) were noted for cultivar F-9809.These differences can be attributed to differences in genotypes to absorb nutrients due to variable rooting pattern. Differences among sorghum cultivars for ash contents have been reported by Mehmud *et al*. (2003) and Ayub *et al*. (2002).

## Conclusion

Significant differences were recorded among the genotypes regarding yield and quality. The genotype F-9603 yielded higher than all other genotypes but it was poor in quality. Quality can be improved by harvesting earlier.

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