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RESEARCH ARTICLE

PERFORMANCE EVALUATION OF SORGHUM VARIETIES IN POTHWAR AREAS OF PAKISTAN.

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Abstract

Twenty sorghum entries were screened for grain and other associated characters at the Barani Agricultural Research Station, Fatehjang, Attock, Pakistan in 2017. These sorghum genotypes showed different attributes against different traits. The results revealed that greater flag leaf area, stem diameter, number of leaves/ plant and plant height was observed in FJSS-09, FJSS-23 and Higari genotypes. Among these entries, higher grain and fodder yield was noted in FJSS-09 (3820 kg/ha & 23456 kg/ha) and FJSS-23 (3643 kg/ha & 22576 kg/ha). The genotype PARC-SS-1 exhibited earliness as it took 111 days to mature while PGRI-191 was found late maturing entry (124 days).

Introduction:-

Sorghum (*Sorghum bicolor* L.) is a major kharif and cereal crop in arid and semi-arid areas of the world. It is also a predominant crop of rain fed areas of Pakistan and is grown both for fodder and grain purpose. It has been estimated that need for forage crops will increase two to three folds in Asian countries upto 2050 (Devendra and Leng, 2011). Sorghum has potential of adoption to adverse climatic conditions and with the introduction of early maturing and high yielding hybrids, the crop has gained importance in the irrigated areas as well. Sorghum fodder possesses oxalic acid and prussic acid. It produces a tonnage of dry matter having digestible nutrients (50 %), crude protein (8 %), fat (2.5 %) and nitrogen free extracts (45 %) (Azam *et al.*, 2010). It can be used fresh as well as can be stored in form of silage and hay for future use. Its grains contain about 10-12% protein, 03% fat and 70% carbohydrates, therefore, it can replace other grains in the feeding program for dairy cattle and poultry (Ullah*et al* ., 2007). Sorghum is also a good subtract for ethanol production which can be added to fuel for saving precious foreign exchange (Reddy et al., 2005). Its grain has high level of iron (>70 ppm) and zinc (>50 ppm), which can reduce micronutrient malnutrition globally. Sorghum is an important summer annual grass and ranks fifth among cereal crops in the world. Sorghum plant is unique in stature and can grow in adverse environments. It has a very large and extensive tap root system that enables it to obtain water and nutrients from soil depth of over five feet. In another study nine sorghum hybrids and 17 varieties were evaluated at 47 locations and hybrids showed higher yields than varieties (Alagarsamy, 1993). Zahid and Bhatti (1994) also reported that sorghum hybrids, having more numbers of leaves/plant and higher leaf area, produced maximum green and dry fodder yields. Moreover, it fulfills more than 50% requirement of the rain fed region of the country. The production of Barley, Jowar, Rapeseed &Mastard and Tobacco has witnessed decrease in production during 2016-17 by posting negative growth of 9.8 percent7.5 percent, 3.2 percent and 2.6 percent, respectively. Average area and production of sorghum was 257 (000 ha) and 149 (000 tones) during 2016-17 (Anonymous, 2016-17). In Pakistan, there are two critical durations for fodder scarcity, first in May-June during summer and second in October-November during winter. Due to stay green trait, sorghum

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improvement for yield and quality characters can greatly reduce the risk of inadequate forage production during summer. Based on these observations, the present study was conducted to evaluate sorghum genotypes potential for their grain and fodder yields and other related traits. The interaction between genotype and environment has been an important factor while selecting the variety for the area (Nawaz *et al.*, 2004).

Material and Methods:-

The present study comprised of twenty sorghum genotypes that were evaluated at Barani Agricultural Research Station, Fatehjang, Attock, Pakistan in 2017. The trial was sown in a randomized complete block design with three replications; each consisted of 45 cm apart and 5 meter long four rows. All other agronomic practices were kept uniform for all the treatments. Ten plants were selected randomly from central 2-rows of each plot for data recording on days to 50% flowering, days to maturity, plant height, stalk and grain yield. Grain yield was adjusted to 15% grain moisture using the formula as prescribed by Taran*et al.* (1998). Grain and stalk yields were recorded and then converted to kg per hectare. The data were analyzed statistically (Steel *et al.*, 1997) and means were compared using least significant difference test through MSTATC computer software (MSTATC, 1991). Detail of sorghum genotypes is given in table 1;

Table 1:-List of sorghum genotypes with source/ location

Sr. No.	Name of Sorghum Genotypes	Source/ Location
01	Chakwal Sorghum	Barani Agricultural Research Institute, Chakwal
02	PARC-SS-1	National Agricultural Research Centre, Islamabad
03	PARC-SS-2	National Agricultural Research Centre, Islamabad
04	PARC-SV-10	National Agricultural Research Centre, Islamabad
05	Johar	National Agricultural Research Centre, Islamabad
06	PGRI-79	National Agricultural Research Centre, Islamabad
07	PGRI-141	National Agricultural Research Centre, Islamabad
08	PGRI-191	National Agricultural Research Centre, Islamabad
09	Rari-S-4	Regional Agricultural Research Institute, Bahawalpur
10	YSS-09	Maize and Millet Research Institute, YousafWala
11	YSS-13	Maize and Millet Research Institute, YousafWala
12	YSS-98	Maize and Millet Research Institute, YousafWala
13	FJSS-02	Barani Agricultural Research Station, Fatehjang
14	FJSS-05	Barani Agricultural Research Station, Fatehjang
15	FJSS-09	Barani Agricultural Research Station, Fatehjang
16	FJSS-23	Barani Agricultural Research Station, Fatehjang
17	FRI-07	Fodder Research Institute, Sargoda
18	SGD-011-2	Fodder Research Institute, Sargoda
19	JS-263	Fodder Research Institute, Sargoda
20	Higari	Fodder Research Institute, Sargoda

Table 2:-List of various traits as exhibitted by Sorghum varieties/advance lines

varieties	Flag leaf area (cm^2)	Stem diameter (cm)	No. of leaves/ plant	Grain yield (kg/ha)	Fodder yield (kg/ha)	Plant height (cm)	Days to 50% flowering	Days to maturity
FJSS-09	32a	17.36a	13a	3820a	23456a	230a	74bc	118bc
FJSS-23	28a	15.52b	12b	3643a	22578a	211b	71bc	115cd
PARC-SS-1	24b	12.97d	12b	3570b	21340bc	192c	67d	111de
Higari	25b	16.41a	13a	3512b	22690b	178d	72bc	116c
Ch. Sorghum	21bc	12.04d	11c	3423b	23780a	202bc	69c	113d
Rari-S-4	18c	14.33c	11c	3354b	21467bc	206bc	72bc	116c
YSS-09	25b	13.01cd	12b	3212bc	20342c	195c	74bc	118bc
FRI-07	23bc	14.49c	13a	3056c	21324bc	172d	79a	123a
SGD-011-2	27a	11.21de	11c	2843c	23675a	201bc	75bc	119bc
YSS-13	15d	10.41e	12b	2713cd	22234b	169d	71bc	115cd
YSS-98	22bc	12.22d	11c	2604cd	21765bc	157e	77b	121b

FJSS-02	19c	14.15c	13a	2534d	20780c	200bc	72bc	116bc
FJSS-05	16d	8.79f	10d	2430d	19342cd	168d	70c	114cd
JS-263	22bc	9.32f	11c	2218de	21546bc	171d	72bc	116c
PARC-SS-2	26b	14.12c	12b	2156de	23820a	195c	74bc	118bc
PARC-SV-10	17d	10.64e	13a	2067e	21640bc	203bc	71bc	115cd
Johar	21bc	12.20d	12b	1845f	22910a	157e	69c	113d
PGRI-79	16d	13.34cd	11c	1723f	20623c	176d	73bc	117c
PGRI-141	19c	12.41d	13a	1645f	19358cd	168d	78a	122a
PGRI-191	24b	14.71c	11c	1578g	20645c	163d	80a	124a
LSD 0.05	**5.12**	**1.76**	**0.87**	**183.11**	**1567**	**15.26**	**2.11**	**2.33**

Results and Discussion:-

Flag leaf area (cm^2):-

The data in table 2 showed that sorghum genotypes differ significantly for flag leaf area. The highest area was observed in FJSS-09 (32 cm) and FJSS-23 (28 cm) followed by Higari (25 cm), while lowest flag leaf area was noted in PGRI-79 (16 cm). The comparison made by Naeem*et al.,* (2002) and Kainth*et al.,* (2004) also reported significant variations among sorghum genotypes for leaf area per plant.

Stem diameter (cm):-

The data revealed that sorghum genotypes showed significant variations for stem diameter. The genotype FJSS-09 showed highest stem diameter (17.36 cm) and Higari (16.41 cm) followed by FJSS-23 (15.52 cm) whereas lowest observation was found in FJSS-05 (8.79 cm). Our findings for stem diameter have also been confirmed by the findings of Naeem*et al.,* (2002) where a range of stem diameter was observed for cultivars.

No. of leaves/ plant:-

Varieties also differed significantly in no. of leaves per plant (Table-2). The highest no. of leaves/ plant was obtained from varieties FJSS-09, Higari, FRI-07 and PARC-SV-10 i.e. (13) followed by FJSS-23 and PARC-SS-1 (12).The lowest no. of leaves/ plant was observed in variety Rari-S-4 and Chakwal sorghum (11).

Days to 50% flowering:-

The data exhibited that sorghum genotypes differ significantly in days to 50% flowering. Sorghum variety PGRI-191 and PGRI-141took maximum days (80 and 78) to 50% flowering than varieties ch. sorghum and PARC-SS-1taking 69 and 67 days to 50% flowering and proved as early maturing. Similar study was also reported by NazirHussian*et al.,* 2011 and Alagarsamy (1993).

Days to maturity:-

The trait days to maturity is usually based on the flowering pattern of genotypes. Days to maturity was significantly affected by sorghum varieties (Table-2). Sorghum varieties PARC ch. sorghum and PARC-SS-1 showed earliness by taking 111 and 113 days to maturity respectively, followed by FJSS-23 (115 days) and Rari-S-4 (116). Genotype PGRI-191 and PGRI-141 were found late, which matured in 124 and 122 days respectively.

Plant height (cm):-

A perusal of data inTable-2 indicated that maximum plant height (230 cm) was recorded in FJSS-09 and FJSS-23 (211 cm), which was statistically at par with Rari-S-4 (206 cm), PARC-SV-10 (203) and Ch. Sorghum (202 cm). While genotype YSS-98 and Johar were found short statured (157 cm). Olakajo and Iken (2001) also reported significant variations in plant height among various maize varieties. The earlier studies conducted by Nabi*et al.,* (2006) and Ayub*et al.,* (2010) for sorghum cultivars also supported our findings for plant height.

Grain yield (kg/ha):-

The analysis of data indicated that sorghum varieties showed significant variations for grain yield. The highest grain yield was obtained from sorghum variety FJSS-09 and FJSS-23 (3820 kg/ ha & 3643 kg/ha), which was statistically at par with PARC-SS-1 (3570 kg/ha) and Higari (3512 kg/ha). Lowest grain yield was observed in PGRI-191 (1578 kg/ha). Similar results were reported by Osmanzai (1994).

Fodder yield (kg/ha):-

A perusal of data (Table-2) revealed that maximum fodder yield was noted in PARC-SS-2 (23820 kg/ha), ch. Sorghum (23780 kg/ha) and SGD-011-2 (23675 kg/ha). The lowest fodder yield was recorded in genotypes PGRI-141 (19358 kg/ha) and FJSS-05 (19342kg/ha). Similar results were also reported by Mehmud*et al.,* (2003). The significant variations among sorghum genotypes for dry matter production have already been reported in studies conducted by Yousef*et al.,* (2009).

Conclusion:-

Based on following results, it was concluded that sorghum varieties differ significantly in their capability of producing higher grain and fodder yield in Potohar region of Pakistan. These results revealed that FJSS-09 and FJSS-23 gave maximum grain yield i.e. 3820 kg/ ha & 3643 kg/ha, whereas maximum fodder yield was noted in PARC-SS-2 (23820 kg/ha), ch. Sorghum (23780 kg/ha) and SGD-011-2 (23675 kg/ha).

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