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Correlation of Economically Important Traits in *Sorghum bicolor* Varieties

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Abstract: The present project was aimed to determine the correlation coefficients among different economically important traits using three varieties of *Sorghum bicolor,* and to ascertain the best combinations of characters to provide an ease to the breeders for improving those characters to improve biomass and yield. The sorghum varieties were PARC SS-1, PARC SS-2, and Pothwar 3-9 as control. The experiment was planted in July, 1998 at National Agricultural Research Centre (NARC), Islamabad in Randomized Complete Block Design (RCBD) with 3 replications. The plant observations were recorded from five earmarked plants in each plot and replication. The characters for observations were plant height, panicle length, 100-seed weight, number of grains/plant, days to 50% flowering, days to maturity, grain yield, stover yield and total dry matter (TDM). All traits were positively highly significantly ($P<0.01$) correlated with one another and yield. These findings indicate great scope for improvement in sorghum yield by improving the traits of 100-seed weight, panicle length, plant height and days to 50% flowering which are important yield components.

Key words: *Sorghum bicolor*, correlation, traits, association

Introduction

Sorghum bicolor (L.) Moench is one of the most important and useful dual purpose summer crops used as food and feed. It ranks fourth among major cereal crops after wheat, rice and maize for its consumption (Rajput *et al.*, 1983). It is an important staple food crop in Africa, South Asia and Central America. Due to its palatability and succulence, it is chopped for silage or fed directly to the animals or as hay and pasture. It has 2% higher protein and 1% lower fat compared to corn (Hughes and Metcalfe, 1972). Sorghum has about the same feed efficiency as corn for laying hens, broilers, lambs and dairy cows. In some areas, its stem is used as building material and plant remains as fuel. It has high yield potential comparable to those of rice, wheat and maize (House, 1985). In Pakistan, sorghum is grown on an area of 0.39 million hectares and the total grain production exceeds 0.231 million tonnes with the yield of 593 kg ha^{-1} (Anonymous, 1998). In most of the countries where sorghum is commonly grown, grain yield of 3000 to 4000 kg ha^{-1} is obtained under stress free conditions and 100 to 300 kg ha^{-1} under moisture limiting environments (House, 1985). Sorghum is adapted to the tropical and temperate climates. It is best known for its adaptation to drought prone semi-arid tropical regions with poor soils as compared to other cereal crops (Murty *et al.*, 1994). Owing to its natural drought resistant qualities, sorghum is a promising crop to overcome the food and feed shortage, particularly in rainfed and arid areas.

Mainly due to non-availability of improved varieties, sorghum grain yield and fodder production are quite low in Pakistan as compared to other countries and needed to be increased. Grain yield and fodder production are complex characters controlled by many genes. The improvement in the traits leads to increase overall productivity of the crop plant.

Materials and Methods

The experimental material comprised of three sorghum verities, i.e., PARC SS-I, PARC SS-2, and Pothwar 3-9. The experiment was conducted during 1998 at research area of Range Land Management at National Agricultural Research Centre Islamabad. The climate of the area is characterized by

Table 1: Correlation coefficients (± S.E.) for economically important traits in sorghum. All values are highly significant ($P<0.01$)

Traits	Panicle Length	100-seed weight	Seeds/ plant	Stover yield	Grain yield	TDM	Days to flowering	Days to flowering
Plant height	0.942 ±(0.014)	0.821 (±0.004)	0.748 (±0.071)	0.816 (±0.002)	0.942 (±0.006)	0.93 (±0.007)	0.893 (±0.027)	0.926 (±0.060)
Panicle length		0.797 (±0.039)	0.818 (±0.487)	0.836 (±0.016)	0.947 (±0.048)	0.937 (±0.062)	0.891 (±0.24)	0.928 (±0.530)
100-seed weight		0.791	0.94 (±0.89)	0.905 (±0.058)	0.919 (±0.377)	0.937 (±0.413)	0.868 (±0.087)	(±0.066)
Seeds/plant				0.909 (±0.002)	0.866 (±0.002)	0.88 (±0.01)	0.850 (±0.004)	0.737 (±0.014)
Stover yield					0.935 (±0.698)	0.954 (±0.698)	0.928 (±0.008)	0.806 (±0.005)
Grain yield						0.998 (±0.026)	0.943 (±0.036)	0.885 (±0.019)
TDM							0.949 (±0.040)	0.880 (±0.022)
Days to flowering								0.916 (±0.009)

hot summers and cold winters by some frost events in January. The mean maximum temperature is 40 °C in June, while mean minimum temperature is 3 °C in January. The mean annual rain fall is about 1000mm, 70% of which falls during summer monsoon and remaining 30% in winter. Soil of experimental area is alluvial, moderately calcareous and its lime content is uniformly distributed throughout the soil profile. It is non-saline, non-sodic with slightly alkaline pH, and is low in organic matter. The seeds were sown on 4th July, 1998 with a tractor mounted drill at a depth of 5 cm with a seed rate of 20 kg ha^{-1}. Study was laid out in Randomized Complete Block Design (RCBD) with 3 replications. Plot size was 3x5 m each with 10 rows, 50 cm apart. Sorghum was allowed to grow in rainfed condition and without use of fertilizers. The plant observations were recorded from five earmarked plants in each plot and each replication during the cropping season and after harvesting. The data were recorded on plant height, panicle length, 100-seed weight, number of seeds/plant (each sorghum plant had only one panicle therefore number of seeds/panicle is equal to number of seeds/plant), days to 50% flowering, days to maturity, grain yield, stover yield and total dry matter (TDM). The data were analyzed by using MSTATC computer software programme and simple correlation was run to determine the correlation coefficients.

Results and Discussion

All the characters studied were significantly correlated with each other in all possible combinations (Table 1). A very strong positive correlation of grain yield with TDM, plant height, panicle length and days to 50% flowering; TDM with 50% flowering and stover yield; plant height with panicle length, and stover yield with 100-seed weight was found. Plant height and panicle length had very strong positive correlation with TDM and grain yield.

All characters studied are the major yield components for sorghum and their association in all possible combinations was obvious. These findings are in agreement with the earlier findings of many researchers (Asthana *et al.*, 1997). Giriraj and Goud (1983) found negative association between seed weight and grains per rachis while we found that 100-seed weight was highly correlated with number of seeds/plant. The varieties we used were single-panicle and their varieties may had more than one panicle. The reduction in seed size may be expected when division of labour and photosynthates occur during grain filling stage. Chalky texture of the seeds of their varieties may be the other reason because loose starch in such seeds reduces the seed weight.

Plant height showed positive significant correlation with panicle length (Table 1) is contrary to the negative correlation between these traits reported by Giriraj and Goud (1983). This may be attributed to genetic material used in their study which was of large height and causing lodging near grain filling stage. Our finding that plant height was positively and high significant and correlated with grain yield was similar to Ekshinge *et al*. (1983).

Panicle length was highly significant and positively associated with grain yield (Table 1). This result is in accordance with Jeyaprakash *et al.* (1997). This positive association may be due to the dependence of panicle length on length and number of internodes. When internode length is shorter, number of internodes will increase, hence number of leaves will increase. Sorghum being a C4 plant will contribute the enhanced photosynthesis towards more yield.

Days to 50% flowering showed significant correlation with grain yield. This result is similar to Youngquist *et al.* (1990), and contrast to Patel *et al*. (1994). Delayed flowering and maturity provides more time for plant to grow and produce more biomass which contributes towards more yield.

All characters are positively and highly significant and correlated with one another and yield. The traits of total dry matter, 100-seed weight, panicle length, plant height and days to 50% flowering are important yield components and can be exploited for any improvement work in *Sorghum bicolor* varieties to improve its overall productivity and production.

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