The specific comparisons made were as follows : 1- variation in vigor am seeds from individual panicles of the same cultivar, 2- variations in vigor am seeds from large and small panicles of the same cultivar, 3- variations in v among seeds from the upper, middle and basal portions of the panicle, 4- eff of nitrogen fertility during seed production on seedling vigor, and 5- effec water stress during seed production on seedling vigor (Maiti, unpublished).

Most of these studies made use of existing seed lots or existing experim from which seed samples could be harvested for specific comparisons. There cultivars and lines used differ between comparisons, as do sample sizes use estimating seedling emergence and seedling vigor. Comparisons between indivi experiments should be made with this caution.

Evaluation of vigor

Seedling vigor was measured first by counting the number of seedlings emer from a standard number of seeds sown, and second, by measuring the total ab ground dry weight for a standard number of seedlings, 15 days after seed emergence. The tests were conducted in wooden flats, 110 X 60 X 22 cm, fi to a depth of 17 cm with field soil. The soil used was a vertisol (black soil wh had been ground, mixed and fertilized with the equivalent of 45 kg/ha of nitro and phosphorous (calculated on a surface area basis). Two seeds were sown hill at a depth of 3 cm, with hills spaced at 10 cm intervals. Furadan was app with the seed to provide protection against the sorghum shootfly (*Antherig* *soccata*) as the tests were conducted under natural environmental condition

Seed source

All comparisons were carried out on seed from pure line cultivars to minin genetic differences among individual seeds or seedlings. The rationale in so do despite the fact that the studies were done to provide information on seed vigor evaluation in breeding materials (including segregating materials), wa follows: if differences in seedling vigor among panicles, seed lots, etc., exi where the genetic variation among these is supposedly at a minimum, then s differences would be important as possible confounding factors in cases wh genetic differences among these factors were the object of selection. Var comparisons were made on seeds from individual panicles or from bulk seed as appropriate to the comparison. The former source was used for the compar of panicle to panicle variation and within panicle variation, and the latter testing the effects of environmental influences during seed production. Gener seed used was not from selfed panicles but as outcrossing in sorghum is conside to be less than 5% (Doggett, 1970), this was not considered to be a ser problem. Specific details of how seed for the individual comparisons was selec is described in the following sections.

Panicle-to-panicle variation

Ten panicles in sequence (approximately 1.5 m row) were collected threshed separately from each of 3 cultivars (M35-1, CSV3 and V302) from irrigated summer season (Feb-May) planting in India. There were signific differences among the seed samples from individual panicles in seed size number of seedlings emerged, but no differences in seedling size (Table 3 There was no evident association between differences in seed size and differen

in emergence for any of the cultivars. Thus, these results agree with those of Abdullahi and Vanderlip (1972) in that differences in emergence within a cultivar are not dependant on seed size.

Table 3.14 Plant to plant variation in seed size and seedling vigor.

	Seedling wt. g/30 seeds		seedlings/ 6 seeds		g dry matter/ 3 seedlings	
Cultivar	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**
M 35-1	1.21	1.02-1.32	5.4	4.7-5.8	0.79	0.70-0.83
CSV3	0.74	0.63-0.92	5.4	4.3-5.9	0.37	0.32-0.43
V302	1.18	1.04-1.29	5.4	4.3-6.0	0.79	0.71-0.89

An additional sampling was carried out to determine if these differences in emergence among seed samples from different panicles were related to differences in parent plant vigor (estimated by the size of the panicle produced by the plant). Five panicles, each from arbitrarily defined large and small panicle - size classes were randomly selected from 5 cultivars (M35-1, CSv3, V302, Patancheru local and IS 1037), taken from the same experiment as the previous sampling. Seed weight and seedling vigor were estimated as in the previous comparison (except that four seeds rather than eight were sown per replicate). There were no differences in either of the three variables measured between the large and small panicle size classes, although individual panicles were significantly different for all parameters.

Within-panicle variation

Five individual panicles each of 4 cultivars (IS 7880, IS 3921, IS 4850 and IS 7755) were randomly selected from an irrigated summer season planting. Each panicle was divided into upper, middle and basal portions, by dividing the rachis into 3 approximately equal segments. Seeds from individual panicles differed in emergence and in seedling size, but there was no effect of location of seed on the panicle on seedling vigor or seed size. Thus the practice of clipping the upper portion of the sorghum panicle following anthesis would not appear to introduce bias in seedling vigor estimates, unless there are genotype X clipping treatment interactions (which were not evaluated). It is feasible to use the seed from the upper portion of the panicle for estimating seedling vigor where selection for vigor on an individual panicle basis was the objective and retain the remaining seed for resowing the lines selected for advancement.

Effects of environmental conditions on seed production

Bulk seed samples from experimental test cultivars under high and low nitrogen fertility conditions and drought stress conditions were used to test the effects of seeds produced in these conditions, on seedling vigor. The seeds for the nitrogen fertility comparison were produced in postrainy season (October-January) crops fertilized with 100 and 20 kg/ha nitrogen for the high and low fertility comparisons respectively. Eight cultivars were used in the study: GPR 148, Q1689, P721, M 316-S. Q2959, CSH1, CS 3541 and M35-1. Seed weight seedling emergence seedling size as the dry weight were estimated. The seed for the drought st effects test was produced in an irrigated dry season planting in which the culti used (IS 1037 and V302) were grown under a fully irrigated (no stress) and st treatments (effected by withholding irrigation) of approximately 25 days dura just prior to flowering and during the grain filling period. Seed weight, seed emergence, and seedling dry weight were estimated.

Seed size in the low nitrogen treatment was less than in the high nitro treatment (Table 3.15), but the effect was mainly due to two cultivars, CSH1 M35-1. Seedling size from seed produced under low nitrogen fertility conditi was also less than that from seeds produced under high nitrogen fertility co tions; and cultivar X treatment interactions were significant. Seed size was redu by both moisture stress treatments although to a much greater degree in grain-filling stress, as expected; it was also reduced in the case of seeds produ in the grain-filling stress, but not in the case of seed produced during the p flowering stage. Seedling emergence was unaffected by either nitrogen or moist stress conditions (Table 3.16).

Table 3.15 Effects of high (HF, 100 kg/ha) and low (LF, 20 kg/ha nitrogen fertilization during seed production generation on seed siz and seedling vigor.

Cultivar	Seed weight g/30 seeds HF	LF	Emergence seedlings/12 seeds HF	LF	Seedling weight g dry matter/6 seedlings HF	LF
GPR 148	0.83	0.85	10.7	11.8	0.65	0.84
Q 1689	0.80	0.77	10.9	10.2	0.77	0.68
P 721	0.67	0.72	11.5	11.6	0.79	0.69
MYX 316-S	0.79	0.73	11.6	11.8	0.97	0.72
Q 2959	0.95	0.87	11.9	11.8	0.90	0.71
CSH-1	1.25	1.15	11.2	11.9	1.09	1.04
CS 3541	0.88	0.82	11.7	11.4	0.72	0.55
M 35-1	1.24	1.13	11.0	11.3	0.82	0.95
X	0.93	0.88	11.3	11.4	0.84	0.77

The results indicated that genotypic evaluations of seedling vigor (seedling or growth rate) should be made only on seed samples produced under the sa conditions. The evidence of genotypes X environment interactions for the nitro fertility comparison suggests that even enhancing evaluations to a common check cultivar for across-location, across-year or across-generation comparis is open to question. This caution does not pose a problem for routine relation vigor, as a given set of breeding lines are usually grown and handled in a unifo manner for other reasons. This caution is important, however, in studies inheritance of seedling vigor or in estimating genetic advance made by selecti

for vigor. In the latter, it may be necessary to specifically produce seeds for such tests under uniform conditions, rather than relying on remanent seeds as is frequently done for measuring effects of selection on yield, diverse resistance, etc.

Table 3.16 Effects of water stress (S) compared to nonstress (NS) during seed production generation on seed size and seedling vigor.

Stress	Seed weight g/30 seeds		Emergence seedlings/12 seeds		Seedling weight g dry matter/6 seedlings	
Pre-flowering						
Cultivar	**S**	**NS**	**S**	**NS**	**S**	**NS**
IS 1037	0.95	0.97	39.2	39.6	1.90	1.92
V 302	0.93	1.10	38.0	37.8	1.65	1.61
Mean	0.94	1.04	38.6	38.7	1.78	1.76
Post flowering						
Cultivar	**S**	**NS**	**S**	**NS**	**S**	**NS**
IS 1037	0.60	0.97	38.4	39.6	1.40	1.92
V 302	0.65	1.10	38.4	37.8	1.20	1.61
Mean	0.62	1.04	38.4	38.7	1.30	1.76

Variability for different crop establishment traits

A set of 100 lines and 2 checks which were basically selected for individual traits, were tested for different crop establishment traits, e.g. emergence under optimum soil moisture, emergence through crust, seed viability following wetting and drying, seedling vigor and drought at the seedling stage. There was a wide range of variability for different traits. A set of 102 sorghum genotypes were evaluated for different crop establishment traits, e.g. soil temperature, viability of seeds, planting depth and seedling vigor (Maiti, 1986). A varying potential for resistance to one or more adverse factors exist in known sorghum genotypes.

Conclusions

The results on seedling emergence and seedling vigor in sorghum could be summarized as follows:

1. Genotypes show many variations and offer much scope in genetic improvement for better emergence and vigor by selection.
2. Different seedling vigor traits show good associations among themselves.
3. Laboratory evaluations of seedling vigor have shown some degree of correlation with field evaluation. Initial evaluation in the laboratory may give some indications about field performance.
4. Seedling vigor is found to show significant positive associations with total biological yield.
5. Visual scoring system may be conveniently adopted for seedling vigor evaluation as it correlates significantly with seedling dry weight and leaf area.
6. Depth of planting and endosperm content have significant effect on seedling vigor but seed size has little or no effect on it.

7. It was possible to screen genotypes for emergence ability through crus adopting a suitable method. The genotypes have shown significant geno variability in seedling emergence through crust.
8. Within and in between genotypes, variations and environmental factors found to influence seedling vigor. Though seed size has little or no effe seedling vigor, genotypes have a major effect on seedling vigor. This nee be taken into consideration in seed production program.
9. There exists a varying potential for resistance to one or more seedling estab ment traits in sorghum.

DROUGHT RESISTANCE AT THE SEEDLING STAGE

Even after good emergence, seedlings may undergo long periods of s before the next rains. To understand the factors affecting seedling establishm attempts have been made with different crops to develop techniques to a germination and early seedling growth under water stress (Nour *et al.*, 1978; Po and Pfeifer, 1956; Sammons *et al.*, 1978, 1979; Sharma, 1973, 1976). Polyethy glycol solutions of known osmotic pressure have been widely used to study ge pic germination differences (Uhvits, 1946; Williams *et al.*, 1967; Saint-Clair, 1 Sharma, 1976). Solutions with different osmotic pressures have been reporte have specific effects on germination, independent of water potential (Parmer Moore, 1968; Sharma, 1973; McDonough, 1976). Selection of drought resista in winter wheat was made by Powell and Pfeifer (1956) using controlled mois systems. A cellulose acetate membrane separating a polyethylene glycol- osmoticum from the soil was modified by Douglas and Asay (1978) to eval seedling emergence. This technique eliminated contact of seed and osmoticum permitted a wide range of soil water potentials. Attempts to screen soybea growth chambers were not successful (Sammons *et al.*, 1978) but screenin drought boxes produced better results (Sammons *et al.*, 1979). The percentag sorghum seedlings surviving after repeated drought stress was found to b useful index for selection (Nour *et al.*, 1978). The technique of growing sorgh seedlings hydroponically with added polyethylene glycol-600 in dish - pans examined by Sullivan and Ross (1979). When the seedlings were 7 to 10 days Carbowax 600 was added to the solution in increments over a three-day pe until a stress of -15 bars was reached. With sorghum, few researchers have b successful in establishing a good technique for seedling drought resistance (N *et al.*, 1978). Drought resistance at later stages in general did not correlate with resistance at later stage of development (Williams *et al.*, 1967; Kilen Andrew, 1969). This needs to be confirmed in future research.

Although the seedling screening procedure adopted earlier appeared to s cultivar differences in drought response, these procedures were not simple (S ivan and Ross, 1979). The relatively sophisticated instrumentation and appar used were cumbersome for mass screening of a large number of germpla (Sammonns *et al.*, 1978, 1979). The usefulness of different techniques for eval ing seedling drought resistance in sorghum is discussed here. The techniq adopted are less complex than those used earlier (details of the techniques a

iscussed in the appendix). At ICRISAT, the author was actively involved in eveloping experiments to evaluate sorghum genotypes for drought resistance at he seedling stage in the field and in semi-controlled condition in flats and greenouses (Maiti & González, 1989).

In all the experiments, limited water (40 mm) was given once following sowing ith no further watering until the seedling showed severe wilting. As the seedlings rew in the depleting soil moisture, drought symptoms were gradually noticed. irst, the seedling leaves showed rolling which is a mechanism to close stomata o reduce transpiration; leaf rolling thus seems to reduce the effective leaf area er plant (Blum, 1974a, 1975a). Some genotypes showed wilting quite early and eached the permanent wilting stage: they did not regain turgor during night and arly morning. Some lines did not show wilting under the same level of soil moisture and maintained turgor; this might be due to higher leaf water potential, he characteristic of drought resistant lines described by Blum (1974a, 1975a). As oil moisture stress increased, seedling growth slowed relative to the degree of olerance of the tissue to drought (Blum, 1979a). When it was assessed that more han 50% of the genotypes would recover after release, the field was rewatered. ome genotypes recovered early, and some long after release of water stress.

Visual scores for wilting and recovery (1 = best, 5 = poorest) and recovery ercentage were taken as indices of drought-resistance. The experiments revealed hat genotypes did differ significantly in different drought resistance indices.

The experiments were complementary to each other. In the wooden flats, the ompeting lines were submitted to stress at the same time. A better water-use fficiency mechanism in a particular line may not be of any use in delaying the tress, because of the competition with the neighboring line for less water conserving capability. If a line has been able to survive, it was because it was able to withstand the stress better rather than its ability to delay the onset of stress. In he PVC cylinders the lines are isolated and if they are more efficient in water use, hey can delay the onset of stress; if they have a builtin tolerance mechanism to withstand the stress better, they can survive still longer.

Considering CV% and LSD, seedling drought evaluation in PVC cylinder in glass house was better than in any other technique, although each technique had ome drawbacks. The correlation coefficients between different drought response ndices for different techniques are given in Table 3.17. The high degree of ssociation between different seedling drought parameters indicates that visual core for wilting and recovery score could be considered as reliable parameters n the screening of genotypes for seedling drought resistance. Seedling vigor (dry weight of seedlings) did show significant positive correlation with seedling drought esistance parameters (visual score for wilting, r= 0.67; plant height, r= -0.50; P $\leq$ 0.01). This indicated that seedling vigor is related to some extent to seedling rought resistance (Maiti and González, 1989). Several germplasm and breeder ines were selected for a high level of drought resistance at the seedling stage. These were IS 2146, IS5604, IS 3962, IS 1096 and (breeding) D 719114 ,D 71914, D 719 , IS 7389 , IS 7389 , D 71873 , D 71824 and BG 74.

Table 3.17 Correlation coefficients among different drought param ters (ICRISAT, 1980). (** P < 0.01).

Parameters	Wooden flats	PVC-cylinder
Visual score for wilting vs recovery score	0.73 **	0.90 **
Visual score for wilting vs % survival	-0.74 **	-0.90 **
Recovery score vs % survival	-0.89 **	-0.99 **
Visual score for wilting wooden flat vs PVC cylinder		0.65 **
Recovery score wooden flat vs PVC cylinder		0.56 **

Table 3.18 t-test between eight glossy and eight non-glossy lines different seedling drought tolerance parameters using different tec niques.

Parameters	Glossy	Non-glossy	t-value
Wooden flats			
Visual score for wilting	2.28	3.50	4.01 *
Recovery score	2.62	3.37	1.96 NS
Percent survival	70.52	48.85	2.45 *
PVC cylinders			
Visual score for wilting	1.75	4.00	6.42 **
Recovery score	1.91	3.69	5.34 **
Percent survival	80.21	39.58	4.22 **
Field			
Visual score for wilting (35 days)	2.62	3.62	1.86 NS
Plant dry weight (35 days)	3.33	2.90	0.97 NS
Plant heighht (30 days)	25.17	20.03	1.99 NS

(NS= not significant; * P<0.05; ** P<0.01; scores: 1=best, 5= poor).

Differential response of glossy and nonglossy lines to drought resistance at seedling stage

In the experiments to evaluate seedling drought resistance, the lines with gl leaf characteristics were more resistant to drought than the non-glossy ones a field experiment that adopted cluster analysis, it was observed that 87% of lines falling in the best group in cluster 1 had glossy leaf surfaces, while 100% the susceptible lines forming cluster 4 were non-glossy. In all these experime the glossy lines showed statistically significant differences from the nonglossy li in different drought resistance characteristics (Maiti, 1986).

When stressed for water, a set of 12 lines (7 glossy and 5 nonglossy) showed significant differences (P < 0.01) in their leaf water potential measured 30 days after emergence. In one of the experiments, stomatal resistance recorded 34 days after emergence showed that the glossy lines had higher resistance compared to the nonglossy lines (glossy 6.9±3.8 sec/cm; nonglossy 5.6±1.8 sec/cm). However, leaf temperatures were the same (31±0.7°C). At the seedling stage, the glossy lines were found to lose less water through transpiration than the nonglossy lines. This was more pronounced up to 11 days.

Seedling growth was generally found to be retarded under water stress in both glossy and nonglossy lines. However, the change in the rate of dry matter accumulation was less in glossy than in nonglossy lines, which indicated that the seedlings of the glossy lines were better adapted to survive drought conditions.

At 22 days of growth there were little differences in the leaf areas of the glossy and nonglossy lines. Thereafter, this factor was not the one responsible for lower transpiration. There were no big differences in root and shoot lengths between the glossy and the nonglossy lines. Although the root length and leaf area of the glossy lines were at par with the 'nonglossy' lines, the water use efficiency of

Table 3.19 Water use efficiency (WUE, g total dry matter/lt water transpired) of glossy and nonglossy soghum (IS= glossy). [a]

Sorghum	WUE	Dry Weight (g) Shoot	Root	Shoot/Root	Reps.
EXP. # 1					
IS-2394	14.6	8.4	2.0	4.2	5
IS-3962	17.3	15.1	3.6	4.2	6
IS-4405	9.0	16.4	4.4	3.7	2
RS 671	12.2	21.6	5.0	4.4	6
CSV5	11.4	11.6	3.4	3.4	6
4449	9.9	11.4	3.5	3.3	6
15701	10.0	11.6	4.6	2.5	2
6205	8.9	14.8	5.3	2.8	3
EXP. # 2					
IS-5567	13.9	14.6	4.8	3.1	6
IS-4405	7.1	12.8	6.4	1.9	4
IS-4621	9.7	20.7	7.3	2.8	2
IS-1096	11.4	15.1	5.3	3.0	4
9040	6.4	11.1	7.0	1.7	6
226	9.0	18.9	7.6	2.5	6
RS 671	10.0	18.2	7.6	2.6	5
15701	9.6	21.8	8.5	2.6	1

a) Plants were grown hydroponically in plastic cylinders (15.4 X 7.7 cm.). In the first experiment, the plants were harvested at 72 days after germination. In the second experiment, the plants were harvested 63 days after germination.

glossylines was significantly higher in terms of water required to produce one g of dry weight, compared to the nonglossy lines ($P < 0.01$, Table 3.18). T reduced transpiration and high water use efficiency might be an adaptation drought situations.

In a study in solution cultures by Sullivan and Maiti (unpublished) glossy li showed higher water use efficiency compared to nonglossy (Tables 3.19, 3.2

Some nonglossy lines (e.g., IS 6077 and IS 7503) showed almost the same le of resistance as the resistant glossy lines. The drought resistant nature of nonglossy lines may be attributed to root system, vascular structure, stoma resistance and some other traits which need to be thoroughly investigated. The fore, recombination of the resistant glossy and nonglossy lines may improve breeding approach to evolve drought-resistant strains. The mechanism of resista in the glossy lines needs to be investigated. Reflectance of sunlight lead to drou resistance. Under a scanning electron microscope (SEM) the glossy crystals w large and flat in shape, whereas nonglossy lines showed no smooth wax and presence of small needle shaped crystals (ICRISAT, 1980; Maiti, 1983).

Saucedo-Rodríguez (1985) showed that there was large variability am sorghum genotypes in resistance to drought which could be correlated with transpiration rate and some biochemical traits (e.g. chlorophyll, carbohydrate, and HCN content). Resistant genotypes showed concentration of these co pounds. With an increase in water stress there was gradual increase in carbo

Table 3.20 Visual rating for drought tolerance of glossy and nonglos sorghums.

Sorghum	Replications (9 plants each) § 1	2	3	4	Mean
IS-1096	1.5	2	3.5	2	2.3
IS-462-1	4-	4	3	5	4.0
IS-3962	1	1	2	3	1.8
IS-4405	2	2	3	2	2.3
IS-2394	4	4	3.5	4	3.9
IS-5567	4-	4	4-	4	4.0
RS-671	5	5	5	5	5.0
4449	2	3	2	2.5	2.4
15701	3	2.5	0	4	3.2
CSV5	3+	3+	3+	3	3.0
6205	3	3	3-	4-	3.3

§ Ratings were 1 to 5, where 1= green plants, in good condition, 2= some plants or leaves showing injury, but remainder of plant was green; 3= about half of plants or plant leaves with dead or dying leaves; 4= severe drought injury, about 1/4 or less of plant with green leaf tissue; 5= dead plants. 0= indicates no plants in that replication.
Drought stress was induced by additions of polyethylene glycol 8000 added to the nutrient solutions in which the plants were growing, beginning at 7 days age. The drought stress was gradually increased to -14 bars at 17 days age. Rating § was done at 21 days.

drate, wax and HCN contents, but with a decrease in chloro-phyll content, subsequently. Terán-H. (1990) reported that there existed significant difference among sorghum genotypes for resistance to drought and also to salinity, showing high genetic advance for some of the stress resistance variables. Some lines were selected to be tolerant to drought and salinity.

Ramírez-Sarquis (1988) showed that glossy sorghum showed higher amount of root resistance to drought at the seedling stage. Glossy lines showed a consistent advantage over nonglossy under short water supply and higher capacity to survive under severe drought and to recover and resume growth sooner than nonglossy lines; glossy lines had higher root systems than non glossy ones (Ramírez-Sarquis, 1988).

Relationship between resistance at the seedling stage and at advanced growth stages

Genotypes that are drought resistant at the seedling stage and which also show a reasonable level of resistance at advanced growth stages need to be identified. Some of the selected lines gave reasonable yields both under irrigated and non-

Table 3.21 Yield (kg/ha) of genotypes (selected for drought resistance at the seedling stage) under control and stress (CSH6, CSH8= checks). Post rainy season, 1980.

Genotypes	Control	Stress
IS-2122	3467	2100
IS-4473	3200	2733
IS-5567	4717	3233
IS-4776	3000	3083
IS-5067	4883	3133
IS-5621	4917	2317
IS-1054	5183	2983
IS-2394	4967	3233
IS-4712	4183	2617
IS-2314	5033	2500
IS-1096	4617	2900
IS-4663	5667	2417
IS-923	4717	2183
IS-2280	4967	2750
IS-5633	4750	2133
IS-4405	3867	3767
IS-5642	5250	2517
IS-8311	2917	2250
IS-2146	4850	2283
CSH-6 (hybrid)	5133	3800
CSH-8 (hybrid)	7233	3017
SE of the mean	214	109
CV %	21	18

irrigated treatments (2900 to 5700 kg/ha in irrigated, and 2100 to 3800 kg/ha non-irrigated plots). The yields of IS 4405, IS 2394, IS 1696 and IS 5567 w comparable to the two standard hybrid checks, CSH-8 and CSH6. This st indicated that selection for drought resistance at the seedling stage might ref to some extent its performance at advanced growth stages (ICRISAT, 1980; Ta 3.21).

Seedling vigor (seedling size) was found to be significantly correlated w emergence through the crust stage. The glossy lines IS 4663, IS 5484 and IS showed reasonable resistance to soil crust and drought at the seedling stage as w as to shootfly (multiple resistance) (ICRISAT, 1981).

In conclusion, we may state that the experiments so far developed to iden genotypes resistant to drought show satisfactory results but need to be improv Once an effective technique is standardized, the loss in yield because of drou can be minimized. Under conditions of severe drought, different genoty decrease their yield due to the effect of drought in varying degree; some genoty give a reasonable yield under drought as well as under irrigated conditions a having an overall high average. These genotypes could have potential both un favorable and unfavorable moisture conditions. Now physiologists and breed are working together to identify characteristics related to drought resistance a venture to create genetic diversity. If a simple morphological trait is found to associated with drought resistance, it would simplify the breeding procedure. T glossy trait in maize is found to be related to drought resistance, and is a sim inherited trait. The identification of glossy trait in sorghum and its relation drought resistance may help sorghum breeders incorporate this trait into elite li for genetic improvement of drought resistance (Maiti, 1986).

SEEDLING MORPHOLOGY

Sorghum germplasm at the seedling stage can be distinguished into 2 disti morphological types: 1) 'glossy', and 2) 'nonglossy'. The glossy lines have light gre leaves with shining appearance. The shining surface is clearly reflected on a sun day, and the appearance is more distinct at an early seedling stage when the glo trait appears. This varies with genotype. In a few genotypes, it appears quite ea even at emergence, while in others it appears quite late, i.e., after about 20 da Scores on a 5-point scale could be given to glossy lines in decreasing intensity leaf color and shining leaf surface.

Glossy lines accounting for less than 1% of sorghum germplasm are mos of peninsular Indian origin, others originate in African countries such as Ethiop Nigeria, northern Cameroon and Republic of South Africa. The glossy lines p an important role in sorghum crop improvement.

Though pigmentation and tillering differences are observed at the seedling sta between lines, they tend to vary with season. In postrainy season, tillering is high and the low temperatures seem to enhance purple pigmentation at the seedl stage. Phosphate deficiency sometimes induces purple pigmentation at the seedl stage.

Within the glossy and nonglossy lines, depending upon the nature of the canopy and the pseudostem, the lines may be further classified into erect and pendant subclasses. The size of leaves enables us to distinguish two morphological groups, broadleaved and narrowleaved, from each subclasses.

SORGHUM GERMPLASMS (SEEDLING MORPHOLOGY)

GLOSSY				NONGLOSSY		
ERECT		PENDANT		ERECT	PENDANT	SEMI-POSTRATE
NARROW LEAVED	BROAD LEAVED	NARROW LEAVED	BROAD LEAVED			

Types of leaves

I - Glossy - yellow green leaves with shining appearance

A. Erect - leaves erect

a) Narrow leaved: Leaves are narrow, leathery lanceolate, and erect with pointed tip. The last expanded leaves make an acute angle of about 30° with each other. The leaf margins are straight.

b) Broad leaves: Leaves are broad, upper ones erect. The first leaf is lanceolate with acute tip and a pseudostem stout. The last expanded leaf makes an angle of about 45°. The lower leaves are semipendant. Leaf margins appear wavy because of twisting of leaves near the tip.

B. Pendant - leaves drooping

a) Narrow leaved: Leaves are narrow, leathery and drooping; the first leaf is narrow with acute tip. Last expanded leaves make an acute angle of about 45°. Margin of leaf lamina straight. Midrib narrow and pale green pseudostem is of medium thickness.

b) Broadleaved: Leaves broad, thick coriaceous and drooping lower leaves lanceolate with acute tip. Last expanded leaves make an acute angle of about 45°, leaf margin twisted to give waxy appearance, midrib pale yellow-green in color, pseudostem medium stout.

II. Nonglossy dark green leaves

A. Erect: leaves broad, semierect, last expanded leaves make an angle of about 60°, first leaf small, oval with broad tip, leaf margin somewhat wavy due to twisting midrib pale green, narrow but strong, pseudostem stout.

B. Pendant : Leaves mediumly broad, drooping, last expanded leaf make an acute angle of about 60°, first leaf is narrow with acute tip, leaf margin gives wavy appearance because of twisting of leaves, midrib narrow, green and weak, pseudostem stout.

C. Semiprostrate : Leaves broad and pendant, leaf margin wavy due to twisting pseudostem is not erect medium thin, appearance of tillers during postrainy season make the plant prostrate in appearance, midrib is narrow weak and green.