4 Results and Discussion

4.1 Geographical Distribution of Wild Sorghum in Kenya

4.1.1 Results

Our survey revealed that wild sorghum is widely distributed in Kenya (Fig. 2), ranging in altitudes from 0 – 1480 m asl. Large wild sorghum populations were frequently observed in the surveyed regions (Fig. 5a, d and e). Wild and cultivated sorghum occur in sympatric ranges and have overlapping flowering windows. Wild sorghum occurs in cultivated sorghum fields, fallow lands, crop margins, other crop fields, and crop fields abandoned due to severe drought, pests, weeds, or extreme nutrients deficiencies. It is also found in protected natural habitats, such as National Parks.

Various wild sorghums (wild, weedy and crop-wild hybrids) were observed in our study (Fig. 5a to e). Wild sorghum types with a closer resemblance to cultivated sorghum occurred mainly in crop habitats. In contrast, wild types with a closer resemblance to true wild sorghum were found in crop margins, while true to type wild sorghum was found mainly in national parks and road sides away from farmland.

Fig. 5a: Wild sorghum in its natural habitat

Fig 5b: Wild sorghum in cultivated sorghum fields

Fig 5c: Wild sorghum in currently harvested cultivated sorghum fields

Fig 5d: Wild sorghum in abandoned fields

Fig 5e: Wild sorghum on the road side

Fig 5f: Wild sorghum on cultivated sorghum field edges and along the river banks

4.1.2 Discussion

The great diversity of wild sorghum populations could be attributed to differences in the adaptation of different wild types to different habitats, human interference via selective rouging and presence of segregating populations derived from wild x crop hybridisation. We frequently observed intermediate types in the fields, reflecting past hybridisation and resultant introgression with cultivated sorghum. Traditional sorghum production is such that weeds, including wild sorghum, are cleared from crop fields by hand pulling. Only those wild types which are difficult to distinguish from cultivated types at the vegetative stage are left to grow through flowering. Some farmers leave some advanced segregating populations to mature and harvest their seeds for food. Though they do not directly replant such segregating populations, these hybrids do contribute to the next generation through pollen- or seed-mediated gene flow. While, the control of wild sorghum is quite intensive in sorghum fields this is not the case at field edges or along the canals as farmers use them for animal feeding, thatching houses, making baskets and seats. Therefore, agricultural practices may have resulted in either depletion or build-up of a seed bank of wild types. Further studies of the ecology, population genetics, and phylogeography of wild-crop sorghum coexistence by investigating wild sorghum status as agronomic weeds, or the extent to which they are sustained as genetically diverse genotypes are needed.

4.2 Phenotypic Diversity of Wild Sorghum

4.2.1 Results

Phenotypic diversity

Great diversity was observed in the field of both cultivated and wild sorghum (Fig. 6). Apparently there was high diversity for all traits analysed (Table 3). Pooled over characters within regions, the mean of *S'* ranged from 0.60 for the Western to 0.93 for the Coast region.

The PCA did not differentiate wild sorghum populations strictly according to regions (Fig. 7). Coast and Turkana populations were differentiated into two groups, with few overlaps. Western populations were not differentiated. Eastern populations were differentiated into three groups. The first three principal components account for 58.03 % of the total variation observed (Table 4). The first principal component (PC1) accounted for 25.76 % of the total variance, and had high contributing factor loadings from glume hair, glume hair cover, awn, glume colour and shattering. The second principal component (PC2) accounted for 21.02 % of the total variation, and had high contributing factor loadings from panicle compactness and shape, inflorescence exsertion, awn, shattering and glume cover. The third principal component (PC3) accounted for 11.24 % of the total variation, and had high factor loadings for grain colour, glume colour, glume cover, shattering and inflorescence exsertion.

a b c d

Fig. 6: A subset of cultivated sorghum (a) and wild sorghum (b, c and d) diversity at a farmer's field in Turkana.

Table 3: Estimates of the standardised Shannon index, *S'*, for ten phenotypic traits in 62 wild sorghum populations grouped by region where collected .

Region	**PCS[1]**	**IE[2]**	**GLC[3]**	**GLCV[4]**	**GH[5]**	**GHC[6]**	**Awn**	**GC[7]**	**GP[8]**	**S[9]**	**Mean±S.E.**
Turkana	0.85	0.80	0.79	0.86	0.84	0.44	0.85	0.85	0.89	0.88	0.81±0.04
Western	0.53	0.63	0.60	0.60	0.62	0.58	0.60	0.60	0.62	0.60	0.60±0.01
Coast	0.78	0.96	0.94	0.97	0.94	0.85	0.95	0.96	1.00	0.98	0.93±0.02
Eastern	0.63	0.73	0.66	0.70	0.70	0.50	0.69	0.72	0.74	0.70	0.68±0.02
Overall	0.80	0.94	0.91	0.95	0.94	0.73	0.94	0.96	1.00	0.94	0.91±0.03

[1]PCS = panicle compactness and shape, [2]IE = inflorescence exsertion, [3]GLC = glume colour, [4]GLCV = glume covering, [5]GLH = glume hairiness, [6]GLHC = glume hair colour, [7]GC= grain colour, [8]GP = grain plumpness and [9]S = shattering.

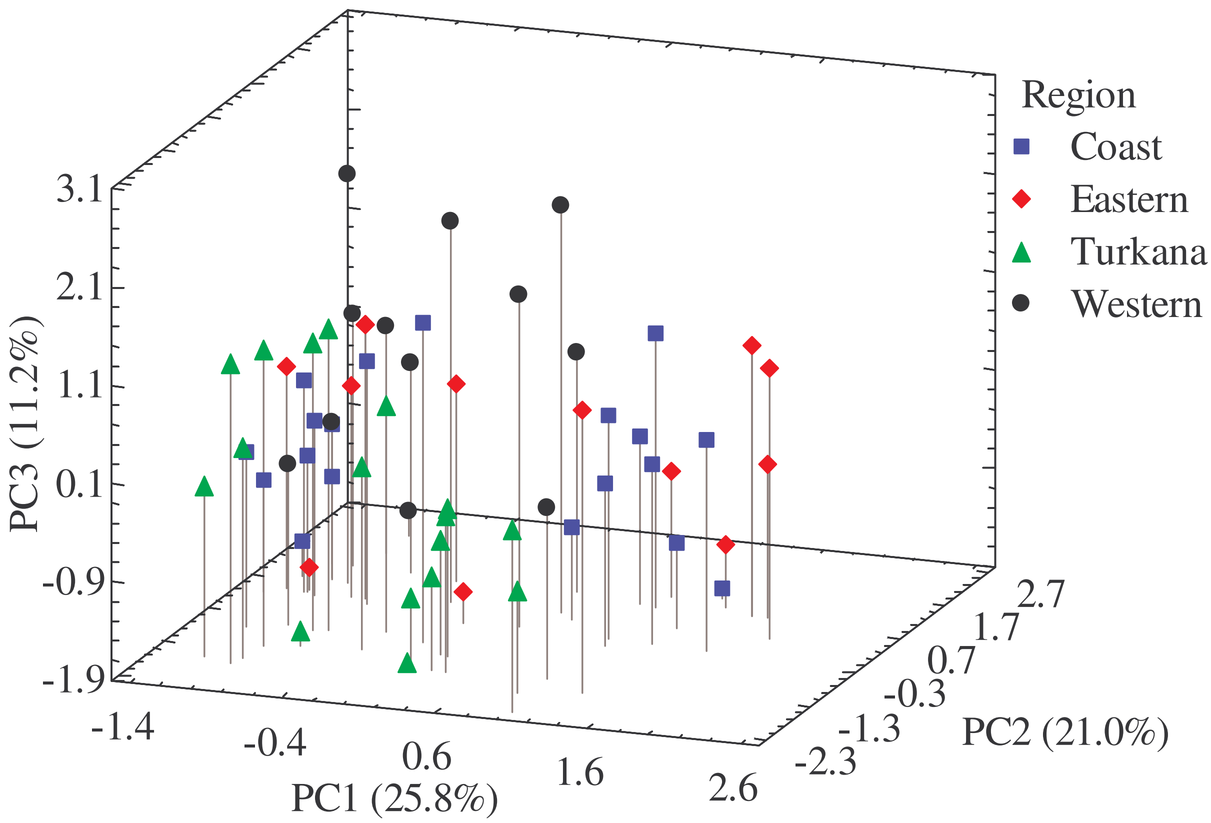

Fig. 7: Principal component analysis (PCA) based on 10 qualitative phenotypic traits in 62 populations of wild sorghum collected from four regions of Kenya. Regions are identified by a different symbol and colour.

Table 4: Factor loadings of the ten phenotypic traits for the first three principal components of a PCA and percentage variance accounted for

Trait	**PC1**	**PC2**	**PC3**
Panicle compactness and shape	-0.35	0.72	0.11
Inflorescence exsertion	0.38	0.67	-0.27
Glume colour	0.41	0.45	0.56
Glume cover	0.36	0.47	-0.38
Glume hair	-0.87	0.30	-0.04
Glume hair colour	0.86	-0.05	0.10
Awn	-0.52	0.56	0.17
Grain colour	0.17	0.17	0.62
Grain plumpness	-0.26	-0.09	-0.18
Shattering	0.38	0.51	-0.36
Percentage	25.76	21.02	11.24