Yield Constraints of Grain Sorghum in Eastern Africa

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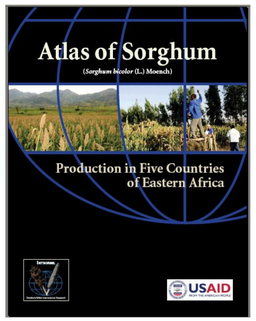
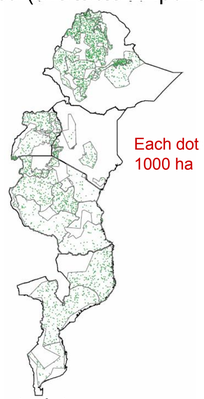
Grain sorghum yields are very low in eastern Africa as compared to yields in the US and well below the genetic potential. The national mean yields range from 0.6 to 1.5 Mg ha^{-1} as compared to 4.3 Mg ha^{-1} in the US (FAOSTAT, 2006). The biotic and abiotic constraints to yield are numerous with a combined effect of much yield loss. In this poster, information on the national and regional importance of the constraints is presented for Ethiopia, Uganda, Kenya, Tanzania, and Mozambique. The information is from *The Atlas of Sorghum Production in Five Countries of Eastern Africa* (available in .pdf at www.intsormil.org).



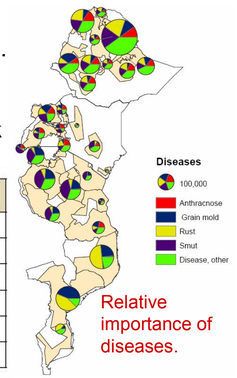


The importance of 43 constraints was assessed assuming that a gap of 4.8 Mg ha^{-1} exists between mean yield potential and actual mean yields. These included 8 diseases, 9 insect pests, 9 related to soil fertility and soil water, and an additional 7 biotic and 7 abiotic constraints. Information on the more important determinates of yield loss is presented in maps using pie charts for each sorghum production area. The diameter of the pie charts varies according to the total yield loss due to that set of constraints.

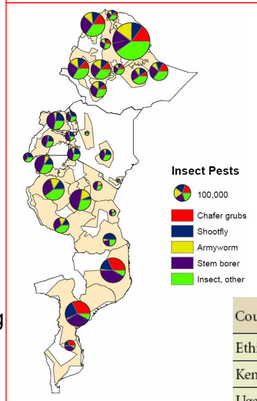
Overview of sorghum production constraints. Soil water deficits accounted for approximately 1.8 million Mg yr^{-1} of loss. The stalk borer complex was found to be the next most important constraint to yield regionally. Total loss of production potential to stalk borer was estimated to be more than 1.1 million Mg yr^{-1}. Nitrogen deficiency was among the top six constraints in all five countries. Striga and other weeds were important; striga was the most important constraint in Kenya, and the second most important in Ethiopia and Uganda. Quelea species, other bird species, shootfly, and phosphorus deficiency each caused more than 0.5 million Mg yr^{-1} loss in production.

Diseases. Rust, smut and grain mold were determined to be the most important diseases constraining yield, and were important in all countries. Rust was recognized as especially important in Mozambique. Anthracnose was of high importance in Kenya, Uganda and lower altitude areas of Ethiopia. Downy mildew was widespread and of moderate importance in all production areas. Ergot and bacterial streak were important in some of the wetter production areas.

Country	Anthracnose	Charcoal rot	Grain mold	Late blight	Mildew	Nematodes	Rust	Smut
Ethiopia	225.3	185.6	204.8	139.9	185.6	139.9	282.1	330.70
Kenya	15.8	11.3	8.1	15.0	8.9	1.0	12.8	20.8
Uganda	32.7	8.8	35.6	13.2	10.2	4.6	20.7	47.2
Tanzania	11.4	12.5	71.2	60.7	23.1	4.1	19.6	111.1
Mozambique	3.6	3.6	100.4	3.6	42.5	3.6	134.5	3.6
Total	288.8	221.8	420.1	232.4	270.3	153.2	469.7	513.4



Relative importance of diseases.



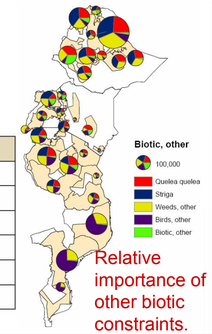
Relative importance of insect pests. Pie size relates to production (ha yr^{-1}).

Insect pests. The stem borer complex was recognized as the most important cause of yield loss among insect pests in all countries. Shootfly was the next important insect pest, especially in Uganda and parts of Kenya. The chafer grub complex and armyworm were important in most production areas of Ethiopia; armyworm is periodically important in Uganda and Kenya. Sorghum midge was of wide importance. The grasshopper/ locust complex was very important lower altitude areas of northwestern Ethiopia.

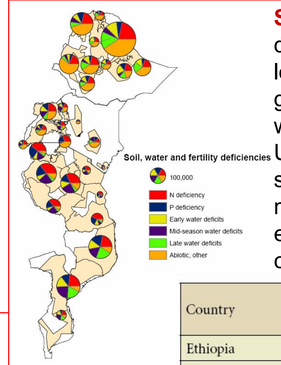
Country	Aphids	Stem borers	Grubs	Grasshoppers/ locusts	Midge	Shootfly	Termites	Armyworm	Cutworm
Ethiopia	209.4	729.8	408.9	266.9	289.4	352.5	14.0	368.7	229.9
Kenya	7.7	46.3	1.0	1.0	18.3	31.5	1.0	9.7	9.6
Uganda	11.3	130.5	2.4	11.7	42.5	76.4	3.3	13.5	19.2
Tanzania	52.6	169.5	4.1	10.2	53.9	40.6	4.1	50.2	13.4
Mozambique	3.6	86.2	72.9	3.6	3.6	44.3	3.6	3.6	3.6
Total	284.6	1162.3	489.3	293.4	407.7	545.3	26	445.7	275.7

Other biotic constraints. Bird damage was a major cause of yield loss, despite much effort to protect crops. Quelea species and striga were very important in all countries except Mozambique.

Country	Domestic animals	Wildlife	Birds, other	Quelea	Striga	Theft	Weeds
Ethiopia	31.5	78.7	122.1	515.3	542.7	16.5	403.7
Kenya	6.1	12.6	32.0	47.2	40.4	1.3	23.8
Uganda	35.9	12.9	54.7	61.0	118.4	15.7	99.8
Tanzania	12.9	47.0	184.2	201.9	205.3	4.1	242.8
Mozambique	3.6	3.6	474.4	3.6	3.6	3.6	177.8
Total	90.0	154.8	867.4	829.0	910.4	41.2	947.9



Relative importance of other biotic constraints.



Relative importance of soil & water constraints.

Soil fertility constraints and water deficits. Soil water deficits were found to be the most important cause of yield loss. Soil water deficits during crop establishment and during grainfill were major constraints in Ethiopia, while mid-season water deficits were of relatively greater concern in Kenya and Uganda. Nitrogen deficiency was a major constraint in all 33 sorghum production areas. Phosphorus deficiency was of moderate or high importance in all production areas, and especially in western Kenya. Other soil fertility related constraints were of only localized importance.

Country	Acid soil complex	Nutrient deficiencies				Salinity	Soil water deficits		
		N	P	K	Other		Early	Mid-season	Late
Ethiopia	25.9	481.7	188.7	14.0	69.9	19.3	287.1	108.4	308.8
Kenya	1.1	43.5	29.2	1.0	2.6	9.8	1.0	24.2	13.3
Uganda	2.8	81.3	45.1	22.6	17.5	3.0	36.9	58.7	30.3
Tanzania	6.9	288.0	159.0	20.8	4.1	26.1	79.4	163.0	41.2
Mozambique	3.6	273.5	179.8	66.6	3.6	3.6	176.5	242.6	246.9
Total	40.3	1168.0	601.8	12.5	97.7	61.8	580.9	596.9	640.5

Other abiotic constraints. Soil crusting was important in parts of Ethiopia and Tanzania. Wind damage was a moderate cause of yield loss in parts of Ethiopia, especially in the eastern mid-altitude production area, and in Uganda. High temperature was a significant constraint in low altitude area of Ethiopia and coastal Kenya. Constraints to root development were locally important in Nyanza Province of Kenya and south western Uganda.

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