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GROWTH AND YIELD PARAMETERS OF SORGHUM GENOTYPES AS AFFECTED BY ARTIFICIAL INOCULATION TECHNIQUES FOR SCREENING AGAINST HEAD SMUT IN NIGERIA

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ABSTRACT
Field trial was conducted at Bayero University, Kano research farm with the aim of determining the effect of stem injection artificial inoculation technique on the growth and yield parameters of one hundred and four sorghum genotypes against head smut. The trial was laid on a randomized complete block design with two replications. Results obtained on the growth parameters which includes plant height, number of leaves and number of tillers per plant have shown that, of the 104 sorghum genotypes screened for head smuts, there was marked reduction in growth parameters in 27 (diseased) plants compared to non- infected (77) plants. Similarly, number of days to 50 % heading as well as grain yield/hectare were significantly (P<0.05) affected in head smut infected plants than in healthy plants, with the former usually having less number of days to heading, as well as less yield than the latter. However, days to 50 % flowering was not significantly (P>0.05) affected even among the diseased plants. The present study have shown that in head smut, plants showing symptoms usually matured earlier and produced less grain yield.
Keywords; sorghum genotypes, head smut, growth and yield parameters, Sudan savanna

INTRODUCTION

Dependence upon plants by humans for their very existence has been traced as far back as more than 13,000 years ago (Singh, 2005) and most of the human food supply worldwide is derived from not more than 20 crops namely: banana, plantain, barley, cassava, citrus, coconut, corn (maize), oats, peanut, pineapple, potato, pulses (beans, peas), rice, rye, sorghum, soybean, sugar beet, sugarcane, sweet potato, wheat and yam (Ahliawate, 2007). In the semi-arid Africa, sorghum is an important food crop for more than 150 million persons, and is usually grown in even nutrient depleted soil and harsh climatic conditions where other crops like maize and rice cannot thrive (Kutama, 2012).

Sorghum (*Sorghum bicolor* (L) Moench) is one of the world's major food crops, particularly in areas of high temperature and low rainfall. Global production is estimated to exceed 40 million hectares, ranking it fifth in importance among cereals (FAO, 2010). It is relatively drought tolerant and can therefore be grown in marginal, semi-arid areas where rainfall is unreliable and the cultivation of food crops such as maize is not feasible. Sorghum is very versatile as a food and feed grain and exhibits wide adaptation and yield stability in marginal areas where it is used as a subsistence staple food. As a consequence, sorghum is important in traditional, low input, cereal based, semi-arid production farming systems in Africa (Norman, *et al.,* 1984).

Many techniques of artificial inoculation in both loose and head smuts have been suggested by many workers. It is however apparent that the appropriate inoculation procedure depends on the route of infection of a particular pathogen and the developmental stage of the host plant at which it is most susceptible. These, plus the question of whether small or large number of sorghum lines is used for the inoculation, partly decide which method mostly fits. One of the conventional as well as accepted of these artificial inoculation techniques is the stem injection (Kutama*et al.*, 2011a, b, c) artificial inoculation used in head smuts screening.

This method has been found suitable for both loose and head smuts. Keay*et al.* (1969) showed that 64 % of 3 - 4 weeks old sorghum plants became infected with loose smut when plants were inoculated with aid of a hypodermic syringe. It is noted that King (1969) employed this technique for screening sorghum collections in Nigeria. However, it is noted that the different inoculation techniques possess different effect on the resultant growth parameters of various sorghum genotypes. This paper report the effect of stem injection artificial inoculation used for screening sorghum genotype against head smut, on the growth and yield of sorghum genotypes in Nigeria.

MATERIALS AND METHODS

Field screening was conducted on research farm of the Faculty of Agriculture, Bayero University, Kano located on 11°58.981N, 008°25.298E and on 454 m elevation during the 2010 growing season.

Randomized complete block design (RCBD) field experiment was conducted. The layout involved two blocks each.

The plot size was 1.5 m long by three ridges each of 75cm apart and one sorghum line/accession was sown per plot at the rate of 3 kg/ha, three seeds per hole and 0.4 m plant spacing (Komolafe*et al.*, 1985).

Each block therefore was comprising of 104 plots and therefore containing the 104 sorghum lines. This was randomized in the second block for each of the two diseases. Sowing was done on 8th to 11th July, 2010.

Agronomic practices

One week after germination, seedlings were thinned to one plant per stand. This resulted in about 15 to 18 plants per plot. First weeding was done manually at 14 days after germination while the second weeding was done four weeks after germination because there was rapid regeneration of weeds two weeks after the first weeding.

Compound fertilizer (NPK, 20:10:10) was applied at the rate of 50 kg/ha (Louis *et al*., 2007) in two equal split doses, one after the first weeding and the next at booting stage.

Artificial Inoculation

Stem Injection Technique

Three weeks after sowing (3WAS), 0.5 g of previously collected, dried and stored teliospores of *S. reilianum*(head smut) were germinated separately in 1 liter of distilled water each for 28 hours and blended for 30 seconds at the speed of 500r/min, using an electric blender in order to obtain a homogenous teliospore suspension. One milliliter of the suspension was introduced into the main stem of the plant with a pediatric syringe by inserting the needle gently into the stem or growing point while carefully holding and supporting the whole plant with a hand to prevent damage. The same procedure was repeated 40 days after sowing (40DAS) where injection of spore suspension was also done at stem or growing point. The plants in both cases were allowed to grow normally up to physiological maturity.

Plant height (cm) was measured at 2 weeks interval after inoculation (WAI) up to 10 weeks after inoculation (WAI). The height was determined by carefully measuring from the base/ground level to the apex or the growing point using a measuring tape. At least two plants were measured from the middle row and the average was taken per plot. The number of leaves per plant was counted from two weeks after inoculation up to 8 WAI at 2-week intervals. The number of tillers per plant was counted fortnightly two weeks after inoculation up to 8 WAI.

The number of days to 50% flowering in a plot was determined by monitoring the number of days when 50% of the plants in each plot came into booting stage. This was calculated from the days after sowing. Number of days to 50% heading was determined by monitoring the number of days when 50 % of the sorghum heads in each plot had produced grains. This was calculated from the days after sowing. When the various cultivars had attained physiological maturity, the sorghum heads from the inner row in each plot were cut, sun dried, threshed and winnowed manually. The grains were weighed. The figures were later converted to kilograms per hectare.

RESULTS AND DISCUSSION

Table 1 shows the growth parameters which include plant height, number of leaves, number of tillers per plant from 2 weeks after inoculation (2WAI) to 8WAI. Plant height significantly varied ($P<0.05$) among sorghum genotypes progressively from 2WAI to 4WAI but the differences were not significant from 6WAI to 8WAI. By the end of 8WAI, sorghum genotype SSV2008013 was the shortest (102.0 cm) while SSV2006045 was the tallest (167.2 cm). However, there was progressive increase in plant height across the growing period.Similarly, the mean number of tillers per plant significantly varied from 2WAI to 8WAI i. e. throughout the period when data was been taken. Significant difference at 5 % probability level was also observed on the mean number of leaves per plant from 2WAI to 4WAI, after which the differences were no longer significant.

The variations in the growth and yield parameters of the diseased plants could be due to differences in the response of the different genotypes to head smut pathogen. Significant reduction in plant height and increased tilleringwas only and earlier on demonstrated by Tarr (1962) in head smutted plants with variations among cultivars but not in head smutted plants. Many authors did not report any shoot stunting in head smutted plants (Kutama*et al*., 2011a). Matheussen*et al*. (1991) noted that some aspects of head smut in sorghum suggest that plant hormones are involved in the disease. Frederiksen (1977) had noted that head smut causes a substantial reduction in plant height and this effect was documented later by Naidoo*et al*. (1991). The occurrence of reduction in height and other growth and yield parameters in most diseased sorghum genotypes in both head smut infected plants observed in present study shows that plant height and other parameters such as tiller number, days to flowering and heading as well as grain yield are important components of the smut diseases. Matheussen*et al*. (1991) attributed these reductions in growth and yield due to GA_3 production in the diseased plant which was earlier noted by Phinney and Spray (1982) who showed that both plant height and sexual development are altered in head smut-infected maize mutants with blocks in their GA_3 biosynthetic pathway. However, the mechanism of GAs in growth reduction is not very clear. According to these authors, when symptoms are less severe (partial infection), the production of GA_3 by the panicle is less affected and dwarfing is not severe. This hypothesis does not exclude the possibility that GAs are also made in the nodes and internodes and thereby influence elongation. GA_3 application to sorghum inhibits tiller production (Morgan *et al*., 1977). Similarly, the great variations in growth parameters of the different varieties might be due to their origin and adaptation. While most genotypes grown in the Sahel and Sudan savanna AEZs tend to mature within 3-5 months, cultivars grown in the Guinea savanna AEZs mature in 4 -7 months period. Another reason for the difference in growth and yield parameters was probably due to late sowing. Early planting has been shown to increase both growth and yield parameters in all crops (David and Adam, 1998) as such late planting may results into reduced growth and yield characters as obtained in this study (Kutama *et al*.,2011b).

Table 1. Mean plant height (cm), number of tillers and number of leaves/ plant of sorghum genotypes screened for resistance to head smut disease

S/N	Sorghum Genotype	Growth parameters at: 2WAI			4WAI			6WAI			8WAI		
		Plht	Tlno	Lfno.	Plht	Tlno	Lfno.	Plht	Tlno	Lfno.	Plht	Tlno	Lfno.
1	SSV2006002	89.45	0.0	8.0	92.65	0.0	9.0	121.1	0	10	130.2	0.5	12.0
2	SSV2006006	73.9	0.0	7.0	90.45	0.0	9.0	90.1	0	8	120.2	1.0	12.0
3	SSV2006007	88.3	0.0	8.0	93.3	0.0	9.0	109.2	0	9	123.4	0.5	12.0
4	SSV2006011	87.2	0.0	8.0	97.3	0.0	11.0	121.1	0	11	132.0	1.0	11.0
5	SSV2006013	78.85	0.0	8.0	89.3	0.0	11.0	111.3	0	10	123.4	0.5	11.5
6	SSV2006014	67.95	0.0	8.0	80.2	0.0	9.0	113.3	0	11	124.5	1.0	12.0
7	SSV2006015	107.35	0.0	9.0	120.1	0.0	9.0	125.3	0	10	140.2	0.5	12.0
8	SSV2006016	84.55	0.0	7.5	90.2	0.0	9.0	102.1	0	9.5	145.0	1.0	12.0
9	SSV2006017	98.3	0.0	8.0	105.3	0.0	8.5	140.3	0	8	167.3	0.5	12.0
10	SSV2006018	105.15	2.0	7.0	113.3	2.0	9.0	121.1	2	8	134.2	2.0	11.5
11	SSV2006021	65.3	1.5	7.0	80.7	1.5	9.0	99.3	1	8	132.0	1.0	11.0
12	SSV2006024	69.05	0.0	7.0	80.4	0.0	9.5	97.5	0	9	121.0	1.0	11.5
13	SSV2006026	63.5	0.0	7.0	78.6	0.0	10.0	98.8	0	9	112.1	0.5	11.5
14	SSV2006027	62.5	1.0	8.0	80.1	1.0	11.5	98.3	0	9	102.1	0.5	11.5
15	SSV2006029	74.3	0.0	8.0	81.3	0.0	10.5	99.3	0	8	102.4	0.0	11.5
16	SSV2006030	73.5	0.0	7.0	83.1	0.0	10.5	93.2	0	8	121.0	0.0	11.5
17	SSV2006031	78.8	0.0	7.0	87.2	0.0	10.5	98.0	0	8	100.9	0.0	11.5
18	SSV2006033	45.9	1.0	7.0	65.3	1.0	11.0	99.1	2	8	114.1	1.0	11.5
19	SSV2006035	86.5	0.5	7.0	95.3	0.5	10.5	102.9	1	8	132.1	0.5	12.0
20	SSV2006036	63.75	0.5	7.0	80.0	0.5	9.0	103.3	1	7	123.1	1.0	12.0
21	SSV2006039	62.95	2.0	8.0	78.1	2.0	8.5	111.1	2	7.5	123.1	2.0	12.0
22	SSV2006041	62.6	0.0	7.5	71.1	0.0	9.0	98.3	0	8	104.3	0.5	12.0
23	SSV2006045	98.68	0.0	9.0	102.0	0.0	10.0	132.1	0	8.5	167.2	1.0	12.0
24	SSV2006047	71.15	1.0	8.0	79.9	1.0	10.5	121.0	1	8	135.4	1.0	12.0
25	SSV2008001	65.9	0.0	8.0	76.2	0.0	9.0	98.8	0	9	123.2	0.0	12.0
26	SSV2008002	67.9	0.0	7.5	67.2	0.0	9.0	100.2	0	8	123.1	0.0	12.0
27	SSV2008004	68.3	0.0	7.5	67.2	0.0	9.0	105.2	0	8	115.5	0.0	12.0
28	SSV2008005	66.3	0.0	7.5	65.1	0.0	9.0	123.2	0	8	142.1	0.0	11.5
29	SSV2008006	63.3	2.5	7.5	69.1	2.5	9.0	123.0	2	9	134.2	1.0	11.0
30	SSV2008007	65.0	0.0	8.0	69.0	0.0	9.0	98.0	0	8	121.1	0.0	10.5
31	SSV2008008	68.2	0.0	8.0	78.1	0.0	9.0	97.3	0	8	124.9	0.5	11.5
32	SSV2008009	61.45	0.0	8.0	77.2	0.0	9.5	98.0	0	7	123.3	0.0	12.0
33	SSV2008010	54.85	2.0	8.0	79.1	2.0	10.0	102.1	2	8	120.9	1.5	12.0
34	SSV2008012	55.55	0.0	8.0	68.1	0.0	10.0	121.2	0	7	143.2	0.0	11.0
35	SSV2008013	64.7	0.0	8.0	65.2	0.0	10.0	112.1	0	8	123.1	0.0	11.0
36	SSV2008017	65.45	0.0	8.0	68.2	0.0	10.0	98.3	0	7	102.0	0.5	11.0
37	SSV2008018	72.55	0.0	8.0	82.3	0.0	10.0	98.4	0	8	103.3	0.0	10.5

Table 1 continue

S/N	Sorghum Genotype	Growth parameters at: 2WAI Plht	Tlno	Lfno.	4WAI Plht	Tlno	Lfno.	6WAI Plht	Tlno	Lfno.	8WAI Plht	Tlno	Lfno.
38	SSV2008019	67.55	0.0	8.0	68.2	0.0	10.0	98.9	0	7	114.4	0.0	11.0
39	SSV2008021	74.75	0.0	8.0	63.2	0.0	9.5	90.0	0	8	117.9	0.5	11.0
40	SSV2008022	62.25	0.0	8.0	65.2	0.0	9.0	87.3	0	9	119.0	0.5	11.0
41	SSV2008023	46.45	1.5	8.0	76.1	1.5	9.0	98.9	1	7	117.0	1.0	11.5
42	SSV2008025	62.5	0.0	8.0	58.1	0.0	9.0	99.8	0	7	113.0	0.5	12.0
43	SSV2008026	71.95	0.0	8.0	60.9	0.0	10.0	98.0	0	7	120.1	0.5	12.0
44	SSV2008028	61.45	0.0	8.0	65.1	0.0	10.0	123.3	0	7	143.2	1.0	12.0
45	SSV2008029	51.95	1.0	8.0	62.1	1.0	10.0	101.2	1	8	123.3	0.5	12.0
46	SSV2008030	57.40	0.0	8.0	69.2	0.0	10.0	98.3	0	8	104.2	1.0	12.0
47	SSV2008031	66.65	0.0	8.0	73.2	0.0	10.0	102.0	0	8	123.2	0.5	12.0
48	SSV2008032	47.1	0.0	8.0	99.0	0.0	11.0	103.9	0	10	132.2	0.5	12.0
49	SSV2008033	58.9	0.0	7.0	81.1	0.0	10.0	89.3	0	9	109.2	0.5	12.0
50	SSV2008034	49.45	0.5	7.5	62.1	0.5	9.0	111.1	0	9	124.4	0.5	12.0
51	SSV2008035	54.3	0.0	7.0	77.2	0.0	9.0	99.0	0	10	121.0	0.0	12.0
52	SSV2008036	65.6	0.0	7.0	74.1	0.0	9.0	123.3	0	10	140.3	0.5	11.0
53	SSV2008039	65.4	1.0	7.0.0	67.1	1.0	9.0	112.2	0	10	132.8	0.0	11.0
54	SSV2008040	87.9	0.0	7.5	65.2	0.0	9.0	132.2	0	10	132.2	0.0	11.0
55	SSV2008041	65.9	0.0	7.0	77.1	0.0	9.0	100.0	0	10	123.3	0.0	10.0
56	SSV2008042	57.05	0.0	7.0	67.1	0.0	9.0	123.1	0	9.5	134.3	0.0	10.0
57	SSV2008044	68.05	0.0	7.0	64.2	0.0	9.0	121.0	0	9	143.2	0.0	11.0
58	SSV2008046	65.5	1.0	7.0	72.1	1.0	9.0	107.4	0	9	123.1	0.0	12.0
59	SSV2008047	58.15	0.0	7.0	74.2	0.0	9.0	123.9	0	9	143.3	0.5	11.5
60	SSV2008048	51.5	0.0	7.0	92.1	0.0	9.0	134.0	0	9	156.0	0.0	11.0
61	SSV2008049	70.75	0.0	7.0	77.1	0.0	9.0	111.1	0	9	113.7	0.5	11.5
62	SSV2008051	54.95	0.0	7.0	67.1	0.0	9.0	102.3	0	9	123.3	0.5	11.5
63	SSV2008052	54.151	0.0	7.0	64.2	0.0	9.0	105.9	0	9	111.2	0.5	11.0
64	SSV2008053	63.05	0.0	7.0	74.2	0.0	9.0	112.9	0	10	123.9	0.5	12.0
65	SSV2008054	66.55	0.0	7.0	85.2	0.0	9.0	110.1	0	10	123.2	0.0	12.0
66	SSV2008055	81.55	0.0	7.5	78.8	0.0	9.0	123.0	0	10	134.4	0.5	12.0
67	SSV2008056	64.55	0.0	7.0	68.9	0.0	10.5	123.9	0	11	143.2	0.5	12.0
68	SSV2008057	94.45	0.5	7.0	64.9	0.5	10.0	143.5	0	10	156.0	0.5	12.0
69	SSV2008058	51.3	0.0	7.0	76.2	0.0	9.5	115.3	0	10	134.2	0.0	10.0
70	SSV2008059	68.03	0.0	7.0	89.2	0.0	9.5	123.3	0	10	123.0	0.5	12.0
71	SSV2008061	72.35	0.5	7.5	87.1	0.5	10.5	121.2	0	9	145.9	0.5	12.0
72	SSV2008063	65.6	0.0	7.0	89.9	0.0	9.0	121.0	0	9	145.2	0.0	10.0
73	SSV2008064	60.15	0.0	7.0	65.2	0.0	9.0	98.2	0	9	121.0	0.0	11.0
74	SSV2008066	57.5	1.0	7.0	89.7	1.0	9.0	121.9	1	9	145.2	0.5	12.0

Table 1 continue

S/N	Sorghum Genotype	Growth parameters at: 2WAI Plht	Tlno	Lfno.	4WAI Plht	Tlno	Lfno.	6WAI Plht	Tlno	Lfno.	8WAI Plht	Tlno	Lfno.
75	SSV2008067	65.0	1.0	7.0	91.1	1.0	9.0	132.1	2	9	145.8	1.0	12.0
76	SSV2008070	81.85	0.0	8.0	66.6	0.0	9.0	111.1	0	10	143.2	0.0	11.5
77	SSV2008072	72.3	0.0	7.0	68.9	0.0	9.0	89.3	0	10	121.0	0.0	11.0
78	SSV2008074	79.8	0.0	7.5	78.9	0.0	9.0	123.1	0	10	145.9	0.0	11.0
79	SSV2008075	62.05	0.0	8.0	78.3	0.0	0.0	118.3	0	11	132.2	0.0	11.0
80	SSV2008076	77.5	0.0	8.0	78.2	0.0	9.5	123.0	0	10	154.8	0.0	11.0
81	SSV2008078	82.0	0.0	8.0	87.3	0.0	10.0	112.0	0	9	156.3	0.5	11.5
82	SSV2008079	57.05	0.5	8.0	67.4	0.0	10.0	110.0	0	9	148.4	0.5	12.0
83	SSV2008080	58.55	0.0	7.0	77.2	0.0	9.5	102.0	0	10	132.1	0.5	12.0
84	SSV2008082	66.6	0.0	8.0	78.4	0.5	9.0	103.3	0	9	127.3	0.5	10.0
85	SSV2008084	66.6	1.5	8.0	65.3	1.5	9.5	104.3	1	9	134.2	1.0	11.0
86	SSV2008085	65.25	2.0	8.0	57.4	2.0	10.0	109.2	2	9	121.0	2.0	11.0
87	SSV2008086	76.55	1.5	8.0	87.3	1.5	9.0	98.2	2	9	112.1	1.5	11.0
88	SSV2008087	65.5	1.0	8.0	76.2	1.0	10.0	98.0	2	9	134.2	2.0	11.0
89	SSV2008088	67.55	1.0	8.0	65.2	1.0	11.0	120.1	2	9	133.3	1.5	11.0
90	SSV2008089	66.35	0.0	8.0	78.2	0.0	9.5	98.3	0	9	132.1	1.0	10.5
91	SSV2008090	57.1	1.5	8.0	65.3	1.5	9.5	112.1	2	10	123.1	1.5	12.0
92	SSV2008094	50.0	0.0	8.0	57.4	0.0	10.5	99.0	0	10	112.0	1.0	12.0
93	SSV2008096	64.55	0.0	8.0	78.3	0.0	9.5	102.9	0	10	130.0	1.0	12.0
94	SSV2008100	65.2	0.0	8.0	76.2	0.0	10.0	121.0	0	9	148.0	0.5	12.0
95	SSV2008101	54.05	1.5	8.0	65.2	1.5	10.0	112.2	2	9	127.8	1.5	12.0
96	SSV2008107	48.65	0.0	8.0	78.2	0.0	9.5	98.9	0	9	132.2	1.0	12.0
97	SSV2008110	58.2	0.0	7.0	72.1	0.0	9.5	111.9	0	9	123.3	0.0	11.0
98	SSV2008111	45.55	0.0	8.0	67.2	0.0	9.0	124.3	0	9	156.3	1.0	11.5
99	SSV2008112	74.35	1.0	7.0	87.1	1.0	9.0	111.0	1	10	163.1	0.5	11.5
100	SSV2008113	57.0	0.5	8.0	68.3	0.0	9.0	134.5	0	10	168.3	1.0	11.0
101	SSV2008116	65.5	0.0	7.0	76.2	0.0	9.5	124.5	0	11	146.3	1.0	12.0
102	SSV2008117	67.6	0.0	8.0	77.2	0.0	10.0	124.4	0	10	134.3	0.5	11.0
103	SSV2008125	70.0	0.0	7.0	78.2	0.0	9.0	123.7	0	10	145.9	0.0	11.0
104	SSV2008181	56.5	0.0	8.0	69.1	0.0	9.5	122.2	0	9	156.9	0.0	10.0
Mean		67.15	0.33	7.591	77.23	0.322	9.51	110.37	0.32	9.76	130.6	0.558	11.5
SE		1.633	0.07	0.0206	0.05946	0.0068	0.0136	0.25	0.091	0.0123	0.0951	0.34	0.490
LSD (0.05)		4.58	0.05	0.4588	0.16677	0.8847	0.8514	9.23	0.83	15.23	5.90	1.3251	1.210

Plht=plant height; Tlno.=number of tillers; Lfno.- number of leaves; WAI= week after inoculation

Table 2. Mean of number of days to 50 % flowering, days to 50 % heading and grain yield of sorghum genotypes screened for head smut

S/N	Sorghum genotype	Days to 50% flowering	Days to 50 % heading	Grain yield (kg/ha)
1	SSV2006002*	67	98	231.8
2	SSV2006006	70	98	340.0
3	SSV2006007	72	92	280.0
4	SSV2006011	76	102	351.0
5	SSV2006013*	80	100	145.1
6	SSV2006014	76	97	238.9
7	SSV2006015	79	104	450.9
8	SSV2006016	90	120	560.0
9	SSV2006017	97	112	439.0
10	SSV2006018	87	113	460.0
11	SSV2006021*	100	140	301.1
12	SSV2006024	89	111	512.2
13	SSV2006026*	76	100	341.1
14	SSV2006027	78	120	321.9
15	SSV2006029	67	110	421.9
16	SSV2006030*	82	109	331.1
17	SSV2006031*	79	98	231.9
18	SSV2006033	81	95	372.0
19	SSV2006035	71	98	412.9
20	SSV2006036	68	10`2	325.8
21	SSV2006039	66	108	421.9
22	SSV2006041	64	105	430.0
23	SSV2006045	81	114	351.9
24	SSV2006047	69	108	351.9
25	SSV2008001	80	92	365.9
26	SSV2008002*	84	99	123.2
27	SSV2008004*	76	98	143.1
28	SSV2008005	83	97	451.9
29	SSV2008006*	100	95	102.1
30	SSV2008007	91	100	345.2
31	SSV2008008	86	104	451.9
32	SSV2008009	101	100	357.0
33	SSV2008010*	91	97	261.9
34	SSV2008012	67	104	348.9
35	SSV2008013	89	120	560.2
36	SSV2008017	87	112	579.0
37	SSV2008018	89	113	451.0
38	SSV2008019	67	140	287.9
39	SSV2008021	65	111	600.9
40	SSV2008022	70	100	567.2
41	SSV2008023	80	120	431.0
42	SSV2008025	68	110	154.7
43	SSV2008026*	59	109	212.2
44	SSV2008028	65	98	234.2
45	SSV2008029*	63	95	217.2
46	SSV2008030*	69	98	356.1
47	SSV2008031*	72	102	569.2
48	SSV2008032	74	108	450.0
49	SSV2008033*	76	87	430.0
50	SSV2008034*	78	99	154.1
51	SSV2008035*	78	98	345.0
52	SSV2008036	80	97	345.0
53	SSV2008039	80	95	432.0
54	SSV2008040	80	98	543.0
55	SSV2008041*	90	99	113.1
56	SSV2008042	81	103	367.0
57	SSV2008044	80	100	621.0
58	SSV2008046	97	119	450.0
59	SSV2008047	78	109	234.1
60	SSV2008048*	69	104	130.0

Table 2 continue

S/N	Sorghum genotype	Days to 50% flowering	Days to 50 % heading	Grain yield (kg/ha)
61	SSV2008049	80	120	378.0
62	SSV2008051*	89	112	214.1
63	SSV2008052	78	113	412.9
64	SSV2008053	69	140	540.0
65	SSV2008054	70	111	542.0
66	SSV2008055	78	100	456.9
67	SSV2008056	79	120	453.0
68	SSV2008057	78	110	432.0
69	SSV2008058	69	109	345.9
70	SSV2008059	78	98	600.0
71	SSV2008061	70	95	541.0
72	SSV2008063	78	98	430.0
73	SSV2008064	69	102	430.9
74	SSV2008066*	69	108	421.0
75	SSV2008067	70	877	453.9
76	SSV2008070	79	99	430.0
77	SSV2008072*	73	98	321.9
78	SSV2008074	78	97	340.0
79	SSV2008075	84	95	541.1
80	SSV2008076	83	98	450.9
81	SSV2008078	78	99	321.0
82	SSV2008079*	76	103	438.0
83	SSV2008080*	78	100	145.5
84	SSV2008082	69	100	165.1
85	SSV2008084	90	110	520.0
86	SSV2008085	78	102	456.8
87	SSV2008086	80	107	437.0
88	SSV2008087*	87	97	560.0
89	SSV2008088*	89	99	567.1
90	SSV2008089	87	100	101.1
91	SSV2008090	79	120	451.0
92	SSV2008094	80	114	348.0
93	SSV2008096	80	112	453.0
94	SSV2008100	78	111	345.0
95	SSV2008101	80	114	437.9
96	SSV2008107	68	112	450.0
97	SSV2008110	68	111	341.9
98	SSV2008111	78	110	398.0
99	SSV2008112*	87	102	119.0
100	SSV2008113	67	107	278.0
101	SSV2008116	98	97	450.0
102	SSV2008117	76	99	560.0
103	SSV2008125	76	100	367.9
104	SSV2008181*	80	120	376.3
	Mean	78.5	105.27	376.3
	S.E.	0	0.4903	377.03
	LSD (0.05)	3.21	1.3751	2.49

* indicates infected genotype

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