EFFECT OF DATE OF PLANTING ON *STRIGA HERMONTHICA* CONTROL IN *SORGHUM BICOLOR*

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Abstract
Seeds of six sorghum (sorghum bicolor) varieties (KSV 8, KSV 4, NR71176, NR71182, ICSV111 and local) were sown at different dates at two weeks interval (15 and 27 June, 9 and 21 July) to evaluate the effect of planting date for Striga hermonthica infestation on the crop under field conditions. The experience was laid out in a randomized complete block design with sorghum varieties in the main plots and different dates constituting the sub plot and replicated three times in 1998 cropping season. Results indicate that sorghum varieties significantly differ in Striga shoots density per m^2 and sorghum syndrome reaction score. Also at 10 WAS the one sown on 27 June had a lower height than other days among the varieties, varieties NR 711182 and ICSV 111 has a lower height (m) than other varieties. At 18 WAS those sown on 15 and 27 June had a lower height than the other days and variety ICSV 111 has the lowest height than others. The late sown crop generally had lower days to booting than the early sown crops. The early sown crops had higher days to ear formation than late sown ones. The late planting significantly delayed Striga emergency by 4-6 days and correspondingly reduced shoot density by 60%, it also reduced Striga development and enhanced sorghum growth hence resulting in significant increase in sorghum yield by over 70%.

Keywords: planting date, sorghum varieties, *Striga hermonthica* management.

Introduction
The parasitic witchweed (*Striga hermonthica* (Del.) Benth) is one of the most serious weeds of sorghum and other cereals in Nigeria. The pernicious and aggressive plant of the scrophulariaceace family parasitizes and cause great yield losses in many cereal crops (Bebawi *et al*. 1984; Lagoke *et al*. 1991). *Striga hermonthica* the most economically important of all *Striga* spp which can inflict crop yield losses of up to 100%. Yield loses caused by the weed are often times significant and complete crop failure could occur. The weed is difficult to control because of the build-up of a large reserve of its seeds in the soil which remain viable for many years.

The continuous increase in *Striga* problem has resulted in farmers been forced to abandon *Striga* infested fields (kanampiu *et al*, 2003). Despite all effort to control the weeds, survey by Lagoke *et al* (1991) indicated that the problem is increasing in terms of spread from farm to farm and ecologically, intensity (population per unit area) and virulence (crop yield losses). Several methods of controlling the weed are recommended but are either incompatible with the cropping system, expensive or unstable and have to be practised over several cropping seasons. Therefore cost effective alternative control methods that are acceptable to small-scale farmers are needed. So far no single control has proved to effectively control weeds. The focus of this work therefore, is a contribution towards cultural control of *Striga* through time of planting. Berner and Ikie (1995) found that the time of *Striga* infestation is critical to its reproduction and yield losses can be minimized if the host crop is protected from parasitism for 4-6 weeks after sowing. Parker and Riches, (1993) reported that *S. hermonthica* emergence is usually highest in the earliest planting and delayed planting can result in reduced *Striga* population. If the number of raining days allows it, the manipulation of sowing late to avoid the period when *Striga* emergence is highest is a good cultural practise.

Early maturing crop varieties are highly essential in this practise so that the gain from *Striga* avoidance is not countered by yield reduction due to late planting. When planting of maize was delayed there was reduced *S. hermonthica* emergence in northern Guinea Savannah of Nigeria (Weber *et al.*, 1995). Hess and Williams (1995) reported that delayed sowing of millet (5-8 weeks) greatly reduced the weed's infestation from 40 to 7m^2. On the contrary, it was observed that *Striga* emerged earlier in the late (July) than in the early (June) sown sorghum at Mokwa (Ngawa, 1992). It was similarly reported by Lagoke *et al.*, (1990, 1991) and Ngawa (1992) that early sown (June) sorghum produced greater yield that that sown late (July) even in a highly infested *Striga* field. Lagoke *et al.* (1991) obtained higher yield in early (July) sown cowpea in a *Striga* infested field than that sown late (August) at minjibir, and weed infestation was higher with late sowing.

The manipulation of crop sowing date for *Striga* avoidance may therefore depend on the crop active and ecology for any increase in yield in a *Striga* infested land. The objective of this study therefore was to evaluate for planting date to escape the effect of *Striga hermonthica* infestation on the crop under field conditions as mention earlier in the abstract.

Material and Methods

A field trail was conducted on a *Striga hermonthica* sick field at the outskirt of Minna (9^0 37N and 6^{0}37E) during the 1998 cropping season in the southern Guinea savannah agro-ecological zone of Nigeria. Ridges 90cm apart were manually constructed with hand hoe at four different times viz: 15 and 27 June, 9 and 21 July after land clearing. Six varieties of sorghum (SKV 8, SKV 4, NR 71176, NR 71182, ICSV 111 and local) were sown 30cm apart on each planting date (15, 27 June and 9, 21 July respectively) and later thinned to three plants per stand.

Each sorghum variety was planted in sub-plots of five ridges wide and two meters long (2m x 4m) which gave a plot size of 4m x 15m with 0.5m guard rows between each crop variety. The treatment were laid in a randomized complete block design and replicated three times. Hoe-weeding was carried out at four and seven weeks after sowing (WAS) at each planting date. Data were taken on days to *Striga* shoot emergence; *Striga* shoot density per m^2; *Striga* shoot/ sorghum plant stand and Visual sorghum damage score (on a scale of 1-10 where 1 indicated no plant damage by *Striga*, 5 was average damage and 10 was severe sorghum damage). Sorghum plant height at 10 and 18 WAS, days to booting; days to ear formation and ear length were also taken at harvest (18 WAS) but data on yield was not recorded due to damage of grains by birds. Data were subjected to analysis of variance using ANOVA according to Genstat 5.2 procedures and the means separation by least significant different at 5% probability.

Results

The effect of sowing data and variety were significant on *Striga* emergence when the crop was sown on 15 and 27 June, and 9 and 21 July. The number of *Striga* shoots in variety KSV 4 was significantly higher than could be found in the other varieties. However, it significantly supported less number of *Striga* shoots when planted on 27 June. There was no significant difference observed between the varieties when seeds were sown in July 9. Varieties KSV 4 and NR 71182 were significantly less supportive of *Striga* emergence than the other varieties.

Table 1: Number of days to Striga emergence

Varieties	Planting date			
	June 15	June 27	July 9	July 21
KSV 8	24.00	30.00	30.30	30.00
KSV 4	30.67	16.00	28.00	20.00
NR 71176	28.00	27.00	30.00	30.00
NR 71182	25.67	28.00	28.00	20.00
ICSV 111	28.00	25.00	27.00	30.00
LOCAL	27.00	27.00	27.00	28.00

Source: Mamudu 1998.

LSD (0.05) Planting date = 5.60
Variety = 4.57
Interaction = 11.20

The interaction effect of date and sorghum variety were significant on *Striga* count per sorghum stand when planted on 15 and 27 and also 9 and 21 July at 10 and 18 WAS (Table 2). The effect of sowing date and variety on *Striga* were. However more significant at 10 WAS than 18 WAS. The interaction effect of sowing date and sorghum variety were significant on *Striga* count per plot on 15 and 27 June and July 9 and July 21 likewise varieties KSV 8, KSV 4, NR 71176, NR 71182, ICSC 111 and local all at 10 WAS and same thing at 18 WAS, also the effect is more significant at 10 WAS then 18 WAS (Table 3). Late sowing resulted in a significantly lower *Striga* count compared with early sowing as shown in table 1 and 2. Earlier workers (Hess and Williams, 1995; Toure *et al*., 1996) have noticed a similar behaviour in other crops. *Striga* numbers were least in the last planting probably because of delayed *Striga* seed stimulation for germination by the host crop due to late planting. This implies that sorghum varieties that marly very early maybe planted late (up to about the third week of July) in this area to avoid *Striga* infestation, and still obtain yield from it. The least *Striga* density was found in NR 71182 which was greatly lower than those for KSV8, ICSV 111 and the local, but not with KSV 4 and NR 71176 (Table 1 and 2). This maybe an indication that NR71182 was more *Striga* resistant than others.

Table 2: Initial striga count per sorghum stand (10 WAS)

Varieties	Planting Date			
	June 15	June 27	July 9	July 21
KSV 8	2.40	2.50	3.60	2.80
KSV 4	1.70	2.90	2.10	0.80
NR 71176	1.60	0.80	4.00	1.70
NR 71182	0.00	1.10	1.70	2.30
ICSV 111	2.40	3.39	4.60	4.30
LOCAL	1.70	2.30	1.70	3.73

Source: Mamudu, 1998
LSD (0.05) Planting date = 0.67
Variety = 0.54
Interaction = 1.33

Final *Striga* count per sorghum stand (18 WAS)

Varieties	Planting Date			
	June 15	June 27	July 9	July 21
KSV 8	3.90	3.10	4.30	3.00
KSV 4	2.10	2.70	3.10	2.20
NR 71176	3.30	2.15	4.10	2.97
NR 71182	2.30	1.80	2.70	3.10
ICSV 111	2.17	4.60	4.60	4.60
LOCAL	2.90	4.10	1.87	3.96

LSD (0.05) Planting date = 0.45
Variety = 0.37
Interaction = 0.90

Table 4: Initial *Striga* count per plot

Varieties	Planting Date			
	June 15	June 27	July 9	July 21
KSV 8	147.50	17.00	41.16	44.60
KSV 4	9.50	23.40	52.20	1.70
NR 71176	23.20	52.80	50.70	6.70
NR 71182	23.30	16.20	42.80	6.40
ICSV 111	9.70	17.30	59.20	7.70
LOCAL	37.00	31.80	18.50	17.80

LSD (0.05) Planting date = 14.58
Variety = 11.90
Interaction = 29.16

Final *Striga* count per plot

Varieties	Planting Date			
	June 15	June 27	July 9	July 21
KSV 8	115.80	43.50	36.10	35.80
KSV 4	12.70	26.40	31.60	6.03
NR 71176	29.40	69.63	54.40	9.20
NR 71182	25.70	19.50	49.60	8.20
ICSV 111	8.20	80.40	65.70	8.95
LOCAL	44.70	50.70	41.20	21.20

LSD (0.05) Planting date = 11.51
Variety = 9.40
Interaction = 23.02

The interaction effect of sowing date and sorghum variety were significant on number of days to ear formation when planted on 15 and 27 June and 9 and 21 July (Fig 1). The average number of days to ear formation were significantly earlier than each other, such that the crop planted latest (21 July) formed ears earliest (average of 78 days) (Fig 2) on the contrary, the one planted on 27 June took the longest time to form ears (average of 111 days). The reducing time of ear formation with planting date might be due to the longer period the crops planted earlier had for vegetative growth as explained by taller plants with earlier plantings. The local variety took the longest time to reproduce (102 days) while ICSV 111 took the least (average of 88 days) (Fig 2). However early KSV 8, KSV 4 and ICSV 111 matured significantly earlier than the local variety. The varietal differences observed in duration of ear formation could be attributed to inherent characteristics which may explain why the local variety took the longest time to reach reproductive stage. Other parameters taken did not show significant differences and are not discussed.

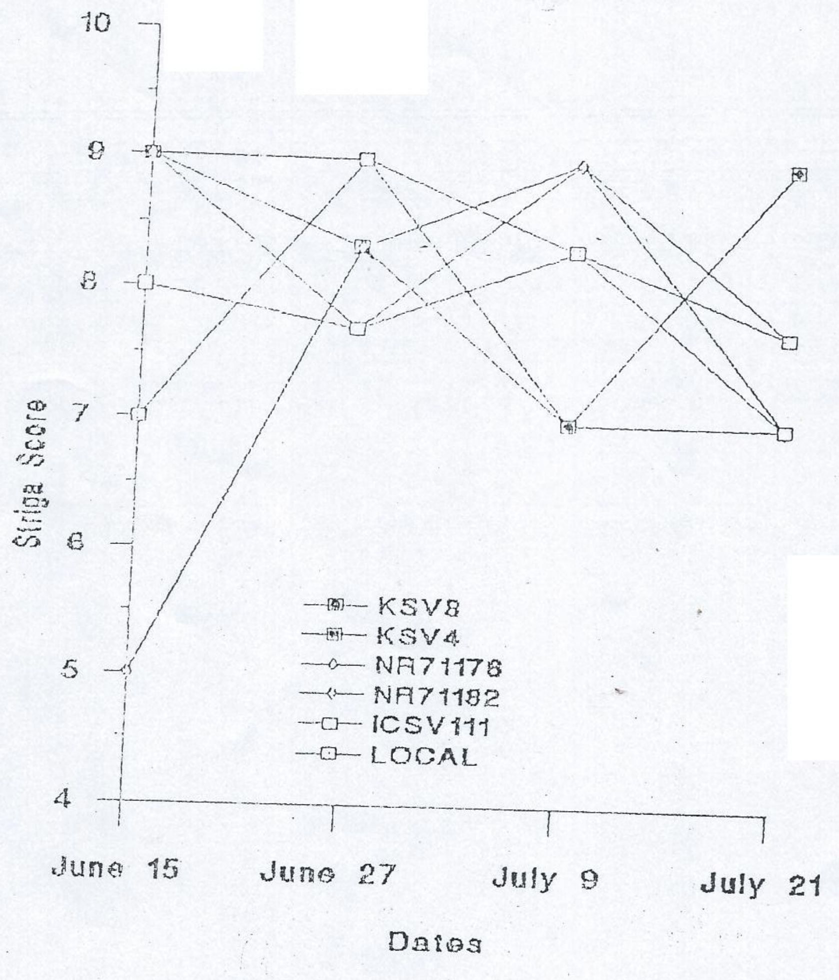

Fig.1:Striga score for severity of attack of striga on sorghum

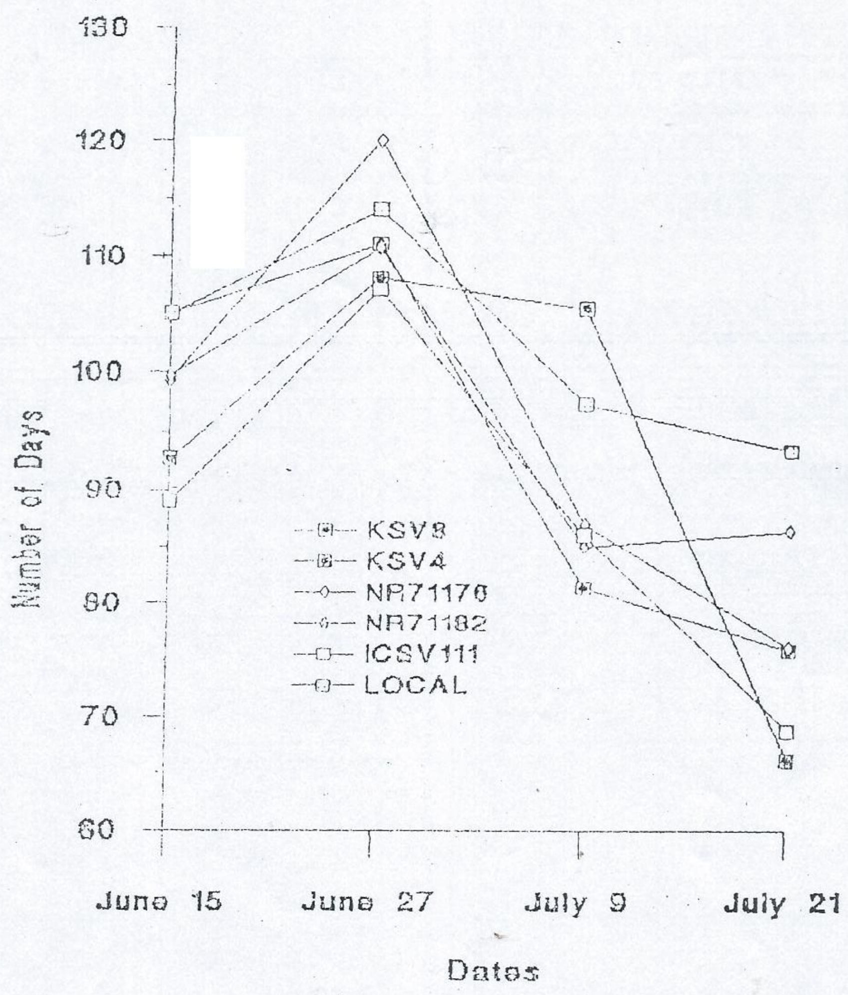

Fig.2:Number of days to ear formation of sorghum

Discussion

The ability of sorghum varieties KSV 4 and NR 71182 to consistently delay S. Hermonthica shoot emergence than the other varieties in the years of shichy could be due to their natural tolerance thereby making *Striga haustorium* attachment to the sorghum variety difficulties as observed by Van *et al*., (2000) also Van Ast and Bastiaans (2006) noted that sensitive of sorghum cultivars was more severely affected by *Striga* than the susceptible ones. The result of their delay in the *Striga* shoot emergence consequently reduced shoot density. This is in agreement with the findings of Kanampiu *et al* (2003). The result of the late sowing that produced lower *Striga* count compared with early sowing is in agreement with the report of earlier workers (Hess and Williams, 1995; Toure et al, 1996). They reported that *Striga* number were least on the last planting probably because of delayed *Striga* seed stimulation for germination by the host crop due to late plating. Ngawa (1991) reported that where rainfall is irate in the early part of the season, the early sown crops maybe affected by an early infection by *Striga*, whereas crop sown later when the rainfall become more regular maybe unaffected until late in the season. The reducing time of ear formation with planting date might be due to the longer period envolved when the crops were planted earlier. This game had vegetative growth as explained by taller plants with earlier planting.

Conclusion

Manipulation of date of planting sorghum for the avoidance of the attack of *Striga hermonthica* can be an effective control method if early maturing varieties are used. Furthermore, S. Hermonthica can be controlled by using resistant/tolerant sorghum varieties.

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