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RESPONSE OF SHORT SEASON MAIZE CULTIVARS TO STRIGA INFESTATION

O. A. CHIVINGE, A. B. MASHINGAIDZE and T. MUJURU
Crop Science Department, University of Zimbabwe,
P. O. Box MP 167, MT Pleasant, Harare, Zimbabwe.

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ABSTRACT

A glasshouse experiment was conducted to assesss tolerance/resistance of five short season maize cultivars namely, CG4141, CG4538, CG4585, PHB3427 and PHB3435 to Striga (*Striga asiatica* (L.) Kuntze) infestation. Striga infested all cultivars but to different levels. Maize (*Zea mays*) height and diameter were only suppressed in cv CH4141. Shoot fresh and dry weights were supressed in all other infested cultivars except PHB3427. All cultivars but PHB3427 and CG4538 were very susceptible with CG4141 suffering the greatest reductions in most parameters. Striga emerged 12 to 17 days earlier in PHB3435 and CG4141 than in PHB3435 and more plants emerged from CG4141 and CG4538. Striga plants supported by CG4141 and PHB3435 flowered earlier than the others. The number of capsules in Striga was lowest in plants which emerged on CG4585 while no capsules were formed on plants growing on PHB3427. Generally, CG cultivars were more susceptible than PHBs. Farmers are recommended to grow cultivars PHB3427 and CG4585 which were relatively more resilient to the weed.

Key Words: Capsules, dry weight, *Striga asiatica*, tolerance

RÉSUMÉ

Une expérimentation en serre était conduite pour évaluer la tolérance/résistance de cinq cultivars de maïs de courte season (CG 4141, CG 4538, CG 4585, PHB 3427 et PHB 3435) à l'infestation de striga (*Striga asiatica* (L.) Kuntze). Le striga avait infesté tous les cultivars à différents niveaux d'attaque. La hauteur et le diamètre du maïs étaient réduits pour le cultivars CG 4141 seulement. Les poids secs de tiges et racines étaient réduits dans tous les autres cultivars infestés, excepté PHB 3427. Tous les cultivars, particulièrement PHB 3427 et CG 4538 étaient très susceptibles; CG 4141 avait connu les plus grandes réductions de la plus part de paramètres. Le striga avait germé 12 à 17 jours plus tôt que PHB 3435 et CG 4141 et plus de plants de striga avaient poussé là où il y avait les cultivars CG 4141 et CG 4538. Les plants de striga sous CG 4141 et PHB 3435 atteignaient la floraison plus tôt. Le nombre de capsules de striga était le plus bas sur les plants qui avaient poussés sous CG 4585 alors qu' il n'y avait pas de capsules formées sur les plants sous PHB 3427. En général, les cultivars CG étaient plus susceptibles que les PHB. Il a été recommendé aux paysans de cultiver les cultivars PHB 3427 et CG 4585 qui étaient capable de récuperer relativement vite après l'attaque de striga.

Mots Clés: Capsules, poids sec, *Striga asiatica*, tolérance

INTRODUCTION

Striga (*Striga asiatica* (L.) Kuntze), which infests large hectarages of maize in Zimbabwe and elsewhere (Parker *et al.*, 1977; Chivinge, 1988), is one of the major biological constraints to high maize yield in the smallholder (SH) farming sector of Zimbabwe. Low erratic rainfall and low fertility found in the SH farming sector (Mashiringwani, 1983) execerbate the reduction in yield due to Striga. Crop yield losses may be up to 100% depending on extent of damage and level of infestation (Ransom *et al.*, 1990; Ejeta *et al.*,1993). Current Striga management practices recommended in Zimbabwe such as use of trap/catch crops, herbicides, high fertilizer rates and early planting, have not been adopted by the SH farmers because of lack of access to resources needed for their implementation. According to Doggett (1988), one of the options available to resource poor farmers is use of resistant/tolerant crop cultivars.

Maize inbreds and hybrids tolerant to Striga were identified by Kim (1988). Ejeta *et al.* (1993) reported maize genotypes which produce low Striga stimulant and haustoria. Curently, there are many short season maize cultivars available to the SH farmers but their response to Striga infestation is unknown. The objective of this study was, therefore, to assess tolerance/resistance of five recently released short season maize cultivars in Zimbabwe, to *S. asiatica* infestation.

MATERIALS AND METHODS

A glasshouse experiment was conducted with temperatures maintained between 25 and 30 °C through use of heated elements. Filter paper was placed at the bottom of asbestos pots (24 cm diameter and 30 cm deep). Pots were filled with sterilised sandy loam soil, which had been mixed with 1.3 g pot^{-1} (equivalent to 300 kg ha^{-1}) of Compound D (8% N, 14% P_2O_5, 7% K_2O), to a level of 10 cm below the top. Sufficiently fertilised soil to fill the remaining upper 5 cm was thoroughly mixed with 1,500 *S. asiatica* seeds. A similar amount of soil was used to fill control pots. Three seeds of CG4141, CG4538, CG4585, PHB3427 and PHB3435 maize cultivars per pot were planted. The pots were placed in lines in a tray. Each cultivar had a control without Striga. Treatments were replicated six times in a completely randomised design. Pots were initially irrigated to field capacity. Thereafter, watering was done regularly to the same level until maize was harvested at physiological maturity. Striga seeds obtained from Henderson Research Station, Zimbabwe, were not preconditioned as this was not necessary (Parkinson, 1985). Maize seeds were supplied by Cragill and Pannar, two commercial seed companies in Zimbabwe.

Maize seedlings were thinned to one per pot, one week after crop emergence (WCE), leaving the healthiest plant. Five grammes of ammonium nitrate (34.5%N) pot^{-1} (equivalent to 250 kg N ha^{-1}) was applied to the maize 4 WCE. Height, stem diameter, shoot and cob fresh and dry weight of maize were measured at physiological maturity. Dry weight was determined by oven-drying shoots and cobs at 80 °C for 72 hr. Number of days to maize flowering was also recorded. Time taken for Striga to emerge and flower, as well as the number of Striga plants per maize plant and capsules per Striga plant were recorded. Striga counts per plant were recorded every two days after emergence of the first plant. Flower number per Striga plant was counted daily after formation of the first one. Capsules were counted when flowers started dropping.

Data were analysed using a two-way ANOVA. The least significant difference ($P \leq 0.05$) separated treatment means. Correlation between Striga counts and the maize parameters was determined.

RESULTS

Height was significantly reduced in infested CG4141 plants only but was similar in the other cultivars, uninfested and infested ($P \leq 0.05$) (Table 1). The decline in height in CG4141 was 17.6%. CG4141, CG4538 and PHB3435 infested plants had significantly ($P \leq 0.05$) depressed stem diameter (Table 1); the depressions being 22.4, 12.4 and 14.2%, respectively. All cultivars showed blotching and drying of leaves which are the symptoms of *Striga* attack. Flowering was significantly ($P \leq 0.05$) delayed in CG4141 but similar in uninfested and infested plants in the other cultivars. Flowering in CG4141 delayed by 10 days.

TABLE 1. Effect of Striga infestation on maize plant height and diameter

Maize cultivar	Height (cm)		Diameter (cm)		Flowering period (days)	
	†Uninf.	‡Inf.	Uninf.	Inf.	Uninf.	Inf
CG4141	225.0	185.8*	5.8	4.5NS	83.7	93.7NS
CG4538	224.0	195.0NS	4.9	4.3NS	90.0	90.3NS
CG4586	202.3	193.7NS	5.0	4.9NS	92.0	97.7NS
PHB3427	232.0	210.0NS*	5.3	5.4NS	96.0	96.0NS
PHB3427	220.0	204.8NS	5.8	5.0NS	97.7	95.7NS
LSD (0.05)	34.9		0.82		10.0	
CV (%)	9.7		0.09		10.6	

† Uninfested
‡ Infested
* Significant ($P \leq 0.05$)
NS = Not Significant

TABLE 2. Shoot fresh and dry weight of maize cvs infested with *Striga asiatica* compared to those not infested

Maize cultivar	Shoot fresh weight (g plant^{-1})		Shoot dry weight (g plant^{-1})	
	Uninfested	Infested	Uninfested	Infested
CG4141	42.16	29.73*	17.30	11.89*
CG4538	44.05	18.38*	17.30	12.43*
CG4585	38.92	32.16*	14.59	12.16*
PHB3427	40.54	38.11NS	15.96	14.32NS
PHB3435	42.16	31.08*	15.41	12.70*
LSD (0.05)	4.86	1.62		
CV (%)	0.49	0.43		

* Significant ($P \leq 0.05$)
NS = Not Significant

Striga asiatica infestation significantly ($P \leq 0.05$) reduced shoot fresh weight of CG4141, CG4538, C94585 and PHB3435 and CG4585 but did not influence that of PHB3427 and PHB3435 (Table 2). A reduction in weight of 58.3%, which was the largest, occurred in CG4538 while CG4585 had the lowest (17.4%). In general, CG cultivars were more susceptible than PHBs. A significant ($P \leq 0.05$) decline in shoot dry weight occurred in infested CG4141, CG4538, CG4585 and PHB3435 plants with reductions of 31.3, 28.2, 16.7 and 17.6%, respectively.

A decline in fresh cob weight (23.8%) occurred only in CG4141 (Table 3). However, cob dry weight was significantly ($P \leq 0.05$) lower in CG4141 and PHB3435 Striga infested plants by 30.3 and 28.1%, respectively.

Striga emerged in 51 to 65 days after maize (Table 4). Striga emergence in CG4141 and PHB3435 was 14 days earlier than for other cultivars. The number of *S. asiatica* plants which emerged per maize plant was similar in all cultivars though it tended to be more in CG4141 and CG4538. Time to flowering in *S. asiatica* was 98 to 115 days. It took a significantly ($P \leq 0.05$) shorter period for *S. asiatica* plants which infested CG4141 and CG4538 to flower than in those which infested CG4585, PHB3427 and PHB3435. CG4141, CG4538 and CG4585 flowered in a significantly ($P \leq 0.05$) shorter period than PHB3435 (Table 4). There were no significant differences in the number of capsules per Striga plant in all cultivars. However, it was comparatively lower in CG4585 but no capsules were produced in plants infesting PHB3427 (Table 4).

There was a negative correlation between the number of *S. asiatica* plants which emerged per

TABLE 3. Fresh and dry cob weight of maize cvs with and without *Striga asiatica* infestation

Cultivar	Fresh weight (g plant^{-1})		Dry weight (g plant^{-1})	
	Uninfested	Infested	Uninfested	Infested
CG4141	17.03	12.97	8.92	6.22*
CG4538	15.41	13.24NS	7.30	6.22NS
CG4585	15.14	13.51NS	6.49	5.68NS
PHB3427	12.97	14.59NS	5.68	6.22NS
PHB3435	14.86	13.51NS	6.76	4.86*
LSD (0.05)	2.43		1.35	
CV (%)	0.62		0.70	

* Significant (P<0.05)
NS = Not Significant

TABLE 4. Number of days to *Striga asiatica* emergence and flowering, number of striga plants per maize plant and capsules per striga plant

Cultivar	Emerged plants (in days)	Emergence period (in days)	Flowering period (in days)	Capsules plant^{-1}
CG4141	0.54	98.0	51.0	3.33
CG4538	0.40	103.0	65.0	3.67
CG4585	0.22	107.0	65.0	1.67
PHB3427	0.32	110.0	65.0	0
PHB3435	0.37	115.0	51.0	3.7
LSD (0.05)	NS	8.0	7.0	NS
CV (%)	0.54	0.04	0.08	1.13

NS = Not Significant

TABLE 5. Correlation coefficient (r) of *Striga asiatica* counts per maize plant and maize plant parameters*

	Counts	Height	Diameter	Shoot FWT	Shoot DWT	Cob FWT
Counts						
Height	-0.485					
Diameter	-0.696	0.799				
Shoot fwt	-0.673	0.719	0.910			
Shoot dwt	-0.704	0.906	0.805	0.861		
Cob fwt	-0.673	0.866	0.900	0.963	0.961	
Cob dwt	0.232	-0.335	-0.416	-0.002	-0.051	-0.054
Flowering	-0.267	0.859	0.852	0.696	0.664	0.750

*Fwt = fresh weight; dwt = dry weight

maize plant and crop height, stem diameter, shoot fresh and dry weight, cob fresh weight and flowering (Table 5).

DISCUSSION

The five maize cvs supported growth of *S. asiatica* and had reduced shoot fresh and dry weight except in PHB3427. However, the differences in response of cultivars to Striga infestation in terms of fresh and dry weight and in the performance of *S. asiatica*, especially in number of plants emerging per maize plant, shows differences in tolerance and infestation levels. Similar results were reported on different maize cultivars (Ransom *et al.*, 1990; Ejeta *et al.*, 1993).

CG4141 supported the highest number of *S. asiatica* plants, and had the shortest period to Striga emergence and flowering, showing that it was the most susceptible cultivar. Based on the measured maize parameters and the performance of Striga, susceptibility of the maize cultivars in decreasing order was CG4141, CG4538, PHB3435, CG4585 and PHB3427. Striga plants which emerged on PHB3427 and CG4585, produced no capsules and the lowest number of capsules, respectively. Hence, with time, the two cultivars would probably reduce *S. asiatica* weed seed bank.

In conclusion, no cultivar was resistant to Striga but CG cultivars were generally more susceptible to *S. asiatica* infestation than the PHB cultivars. CG4141 was the most susceptible and PHB3427 the least. Farmers using CG4141 should avoid using *S. asiatica* infested fields. Cultivars which are more tolerant such PHB3427, CG4585 are recommended.

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