Stewart's wilt reactions of South African maize varieties inoculated with *Erwinia stewartii* in field and greenhouse trials

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Eight maize hybrids available commercially in the South Africa and the S_1 generation of 25 South African varieties had resistant or moderate reactions to Stewart's wilt based on two years of field trials in Urbana, IL, USA. On a 1 to 9 scale, Stewart's wilt ratings for the S_1 generation of 25 South African varieties ranged from 2.0 to 3.9 with a mean of 2.8 in 1999, and from 1.9 to 3.8 with a mean of 3.2 in 2000. Means for the eight commercially-available hybrids ranged from 2.1 to 3.2 in both years. Susceptible hybrids included as controls had Stewart's wilt ratings from 4.1 to 5.0. The levels of resistance in the maize lines from South Africa are sufficient to minimise the effects of Stewart's wilt on yield. Therefore, the unlikely introduction of *E. stewartii* to southern Africa would have very little effect on the performance of the South African varieties evaluated in this study. Stewart's wilt reactions of South African varieties and US hybrids included as controls were inconsistent in four greenhouse trials with a limited number of replicates. Thus, the greenhouse evaluations did not provide the same degree of accuracy as field trials. This information is important in assessing the potential risk of introducing *E. stewartii* to southern Africa, and it informs breeders and pathologists in southern Africa about potential sources of resistance to Stewart's wilt in germplasm that is highly adapted to the region.

Key words: corn, *Erwinia stewartii,* maize, *Pantoea stewartii,* South Africa, Stewart's bacterial wilt, *Zea mays.*

Stewart's bacterial wilt, caused by *Erwinia stewartii* (Syn. *Pantoea stewartii*), is an important disease of maize (*Zea mays* L.) in the United States (Pepper 1967). Stewart's wilt occurs primarily in the mid-Atlantic States, the Ohio River Valley and the southern part of the US Corn Belt (Pepper 1967). *E. stewartii* has also been reported sporadically from Italy, Romania and Poland (CABI 2002). The occurrence of Stewart's wilt epidemics in the USA fluctuates with the population dynamics of the maize flea beetle, *Chaetocnema pulicaria* Melsh., the vector and overwintering host of *E. stewartii* (Elliott & Poos 1934). Other insects, including the toothed flea beetle, *Chaetocnema denticulata* Ill., have been identified as inefficient vectors of *E. stewartii* under controlled greenhouse conditions (Elliott & Poos 1934) but their role, if any, in disseminating *E. stewartii* in field situations has not been established.

There are two main phases of Stewart's wilt, the seedling wilt and the adult leaf blight phases. Yield reductions are primarily the result of systemic infection of seedlings. Ear mass and size are reduced when sweetcorn hybrids with moderate to susceptible reactions are infected systemically (Suparyono & Pataky 1989a,b; Freeman & Pataky 2001). Stewart's wilt has little effect on yield of most field maize hybrids grown where the disease is endemic because adequate levels of resistance prevent or limit systemic infection by restricting the movement of *E. stewartii* within the xylem of infected plants (Braun 1982). Also, systemic infection occurs only rarely during the leaf blight phase of Stewart's wilt, thus limiting the impact of this phase of the disease.

Many countries throughout the world place quarantine restrictions on *E. stewartii,* although the risk of introducing *E. stewartii* through maize seed produced on moderately resistant seed parent plants is exceedingly low (Khan et al. 1996; Block et al. 1998,1999; Michener et al. 2002a,b). Based on relatively low rates of *E. stewartii* seed transmission and improved methods of detecting seedborne *E. stewartii* (Lamka et al. 1991), many countries, including South Africa, are re-evaluating and revising quarantine regulations for *E. stewartii.*

An important factor to consider when assessing the risk of introducing *E. stewartii* is the potential economic damage that might occur if the bacterium is introduced to areas where it is not endemic. The economic impact of *E. stewartii* would be affected principally by yield losses due to Stewart's wilt although phytosanitary restrictions imposed by trading partners, additional costs of control, and other secondary costs must also be considered as

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part of the economic consequences of introduction. The effect of *E. stewartii* on maize yield depends partially on the Stewart's wilt reactions of maize varieties grown in the area of introduction.

Recently, an international collection of maize germplasm that included nearly 2000 lines was evaluated for Stewart's wilt reactions following inoculation with *E. stewartii* (Pataky et al. 2000). In this study, many maize accessions from the mid-Atlantic region and the Ohio River Valley of the USA, where Stewart's wilt is endemic, were resistant or moderately resistant to Stewart's wilt. Lines from this region had a mean Stewart's rating of 3.1 on a 1 to 9 scale. Reactions of most accessions from other areas of the USA and throughout the world ranged from moderately resistant to susceptible with a mean Stewart's wilt rating of 4 (Pataky et al. 2000). Twenty-five accessions collected from South Africa had a mean Stewart's wilt rating of 4.1 with a range of 2.3 to 7.3. Two accessions were rated between 2 and 3 (moderately resistant), 19 were rated between 3 and 5 (moderate), and 4 were rated greater than 5 (susceptible). The reactions of these accessions indicate that there is a range of response to Stewart's wilt in germplasm from South Africa. However, these accessions that included land races and lines derived from commercial cultivars may not be representative of germplasm currently grown in southern Africa. Germplasm that is representative of currently grown hybrids and cultivars should be evaluated in order to more accurately assess the potential damage that could result if *E. stewartii* becomes established in southern Africa.

The objectives of this study were to evaluate a sample of maize germplasm from South Africa for reactions to Stewart's wilt and to compare greenhouse and field methods of evaluation.

Materials and methods

Varieties evaluated

Twenty-nine maize varieties selected as being representative of maize presently grown in South Africa were evaluated for reactions to Stewart's wilt in field and greenhouse trials. The varieties obtained from M Bolten, Directorate of Plant and Quality Control, National Department of Agriculture, South Africa, included F_1 hybrids and open-pollinated cultivars. Seed of the South African maize varieties could not be planted directly in field trials in the USA due to phytosanitary regulations, including those for maize streak virus. Eight seeds of each variety were planted on 6 November 1998 in a soil-bed in a quarantine-approved greenhouse. Plants were self-pollinated to produce the S_1 generation. Seed was harvested on 8 April 1999 from 25 of the 29 maize varieties and bulked by variety. Additional seed was produced for eight varieties the following winter, 1999/2000.

Field evaluation

The S_1 generation of 25 and 19 varieties were planted on 17 May 1999 and 5 May 2000, respectively, at the University of Illinois South Farms, Urbana, IL, USA (Table 1). Seven sweetcorn, two yellow dent maize and 12 white food-grade maize hybrids with previously determined reactions to Stewart's wilt were planted as controls (Table 1). The S_1 generation of the sweetcorn, dent maize and food-grade maize hybrids were produced by self-pollination in 1998 and also included as controls. The S_1 generation of sweetcorn hybrids were not planted in 2000 due to insufficient quantities of seed. Eight commercial hybrids grown in South Africa for which F_1 hybrid seed was available in the USA were also included in the trials (Table 1). The experimental design was a randomised complete block with four replicates. Experimental units were a single 3.5-m row for hybrids and two 3.5-m rows for S_1 generations. Each row contained approximately 16 plants.

Plants at the three- to six-leaf stages were inoculated three times with *E. stewartii* by the pinprick method (Chang et al. 1977). Inocula were produced as shake cultures in nutrient broth. Leaf tissue from about five naturally-infected seedlings was surface-disinfected for 10 seconds in 95 % ethanol and rinsed twice in sterile deionised water. Symptomatic areas of leaf tissue were cut into approximately 20 1.5 cm^2 pieces that were placed in 1.5 l of nutrient broth. Inocula were incubated on benchtop shakers at room temperature overnight. Seedlings were inoculated with the bacterial suspension diluted 1:10 in a 0.1 M solution of NaCl. Seedlings were inoculated on 4, 8 and 17 June 1999 and 31 May and 5 and 8 June 2000. Plants were rated for Stewart's wilt symptoms on 23 June and 23 July 1999 and 28 June 2000. Since Stewart's wilt reactions may have been segregating within S_1 progeny and within open pollinated varieties, individual plants were rated for Stewart's wilt symptoms in each experimental unit. Plants were rated on a 1 to 9 scale (Fig. 1), where 1 = no appreciable spread of symptoms from inoculation

Table 1. Stewart's wilt rating from 1 to 9 for various maize lines evaluated in field trials in 1999 and 2000.

Variety	1999	2000	Variety	1999	2000
South African varieties S_1			**Sweetcorn hybrids and S_1**		
Border King	2.7	3.1	How Sweet It Is (*M*)	3.7	3.6
Carnia CRN 3414	3.4	3.7	How Sweet It Is S_1	4.7	–
Carnia CRN 3524	2.9	–	Pegasus (*MS/S*)	4.6	5.0
Carnia CRN 3549	3.1	3.6	Pegasus S_1	3.6	–
Carnia CRN 3604	2.6	–	Summer Sweet 781Ultra (*MR*)	3.2	3.1
Carnia CRN 3631	2.8	3.2	Summer Sweet 781Ultra S_1	3.4	–
Carnia CRN 3760	2.6	3.5	Snowbelle (*MS/S*)	4.9	4.4
Carnia CRN 3815	2.1	2.3	Snowbelle S_1	4.0	–
Carnia CRN 3891	2.0	2.4	Viva (*M/MS*)	3.7	3.4
Hikory King	3.2	–	Viva S_1	4.8	–
'Maize Madonella'	3.0	2.8			
Pannar PAN 6043	3.1	3.3	**Dent maize hybrids and S_1**		
Pannar PAN 6146	2.9	3.3	B73 × Mo17 (*R*)	–	2.9
Pannar PAN 6243	3.6	3.7	B73 × Mo17 S_1	–	3.1
Pannar PAN 6256	2.7	–	Dekalb DK739W (*R/MR*)	2.9	2.9
Pannar PAN 6321	2.2	–	Dekalb DK739W S_1	2.9	3.0
Pannar PAN 6414	2.1	–	Dekalb DK742W (*R*)	2.0	2.0
Pannar PAN 6471	2.1	1.9	Dekalb DK742W S_1	2.1	2.6
Pannar PAN 6480	2.3	3.0	Dekalb DK 631W (*MR/R*)	–	3.3
Shamrock Yellow OP	2.7	2.8	Dekalb DK 631W S_1	–	3.3
Sensako SNK 2021	2.1	2.7	Dekalb EXP866W (*R*)	2.8	2.8
Sensako SNK 2147	3.9	3.8	Dekalb EXP866W S_1	2.5	2.6
Sensako SNK 2220	3.2	3.8	Dekalb EXP868W (*R*)	2.4	–
Sensako SNK 2266	3.1	3.4	Dekalb EXP868W S_1	3.2	–
Sensako SNK 2472	3.3	3.7	LG Seeds LG2558W (*MR/R*)	–	3.3
			LG Seeds LG2558W S_1	–	3.1
South African F_1 hybrids			Pioneer 3394 (*R/MR*)	–	3.1
Sensako SNK 2021	2.4	2.1	Pioneer 3394 S_1	–	3.1
Sensako SNK 2042	2.9	3.2	Pioneer 3281W (*R*)	2.6	–
Sensako SNK 2147	2.7	3.0	Pioneer 3281W S_1	2.8	–
Sensako SNK 2151	3.2	3.1	Pioneer 3283W (*R*)	2.3	–
Sensako SNK 2220	2.9	3.1	Pioneer 3283W S_1	2.3	–
Sensako SNK 2265	2.6	2.7	Pioneer 3287W (*MR/R*)	3.0	–
Sensako SNK2665	2.4	2.6	Pioneer 3287W S_1	3.0	–
Sensako SNK 2888	2.7	2.8	Pioneer 3443W (*R/MR*)	3.0	–
			Pioneer 3443W S_1	3.2	–
Sweetcorn hybrids and S_1			Trislers 4214W (*R*)	1.9	1.7
Argent (*R/MR*)	3.2	2.9	Trislers 4214W S_1	1.9	2.2
Argent S_1	3.3	–	Whisnand 50AW (*R*)	–	2.2
Frontier (*MS*)	4.1	4.2	Whisnand 50AW S_1	–	2.5
Frontier S_1	4.3	–			

FLSD (α = 0.05) for comparison of treatment means: 1999 = 0.41, 2000 = 0.45.
Stewart's wilt reaction of standard control hybrids in brackets: *R* = resistant, *MR* = moderately resistant, *M* = moderate, *MS* = moderately susceptible, *S* = susceptible.

wounds; 2 = limited water-soaking, chlorosis or necrosis within 3 cm of wounds; 3 = limited spread from wounds, chlorosis or necrosis predominantly towards tips of leaves; 4 = abundant spread from wounds, chlorosis or necrosis towards both ends of leaves; 5 = minimal systemic infection, a few symptomatic streaks on non-inoculated leaves; 6 = moderate systemic infection, symptoms on 5–25 % of the leaf area, minimal stunting; 7 = abundant systemic infection, symptoms on 25–50 % of the leaf area, distinct stunting; 8 = 50–90 % of the leaf area symptomatic, severe system infection and stunting; 9 = 90–100 % of the leaf tissue symptomatic or dead plants. Ratings ≤3 denote limited spread of *E. stewartii* that is indicative of resistant or moderately resistant reactions.

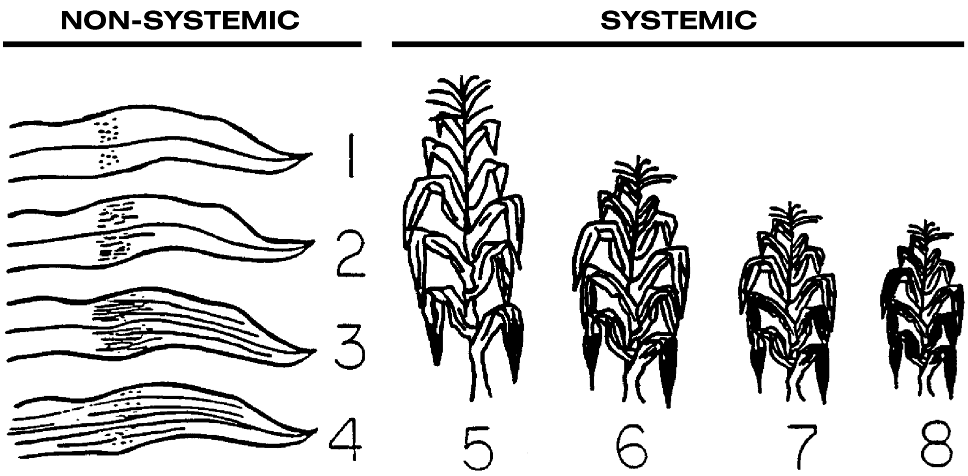

Fig. 1. Scale from 1 to 9 used to rate Stewart's wilt reactions of maize plants following inoculation with *Erwinia stewartii*. Ratings 1 to 4 represent different degrees of non-systemic movement of *E. stewartii* from inoculation wounds and ratings 5 to 8 represent different degrees of systemic infection of plants. Dead plants are rated 9.

Ratings of ≥5 denote systemic infection by *E. stewartii* that is indicative of moderately susceptible or susceptible reactions. Means of experimental units were analysed by ANOVA. Mean Stewart's wilt ratings for varieties were compared by FLSD-values. Ratings of varieties in both trials were compared in a combined ANOVA. Variances were compared between F_1 hybrids and their S_1 generation with Hartley's test (Hartley 1950). Relationships between early and late ratings in 1999 and ratings in 1999 and 2000 were examined by correlation analysis. Stewart's wilt reactions of varieties were classified as resistant, moderate or susceptible based on FLSD-values, the relationship between ratings and levels of systemic infection, and reactions of control hybrids with previously known Stewart's wilt reactions. Varieties were considered to be resistant, moderate, or susceptible when rated ≤3, from 3 to 4.5, or ≥4.5, respectively. Rows of varieties with resistant reactions typically did not contain any systemically infected plants. Rows of varieties with moderate reactions contained an occasional systemically infected plant. Rows of varieties with susceptible reactions typically contained several systemically infected plants.

Greenhouse evaluation

Seed of 29 South African varieties were planted in quarantine-approved greenhouses in December 1998, March and November 1999, and January 2000. Seed of twelve sweetcorn and white, food-grade maize hybrids with previously determined reactions to Stewart's wilt were included as controls. The experimental design was a randomised complete block with two or three replicates. Experimental units were about eight plants grown in individual pots or in a single row of a 6-row, 30 × 60 × 7 cm flat.

Inocula were produced in shake cultures as described above. Naturally-occurring isolates of *E. stewartii* were collected the previous summer and maintained as a bulked population on plants in a greenhouse. Plants were inoculated three weeks after emergence by wounding leaf tissue in the whorl five times with a syringe and injecting 1 ml of inoculum into wounded whorls. Individual plants were rated for Stewart's wilt symptoms using the 1 to 9 scale described above. Means of experimental units were analysed by ANOVA in each trial. Varietal means were calculated and compared by FLSD-values in each trial and in a combined ANOVA. Varietal means from greenhouse trials were compared with those from field trials by correlation analysis.

Results

Field evaluation

Stewart's wilt ratings of varieties were highly correlated among years (Fig. 2). However, the variety by year interaction was highly significant in the combined ANOVA and varieties were therefore compared within years (Table 1).

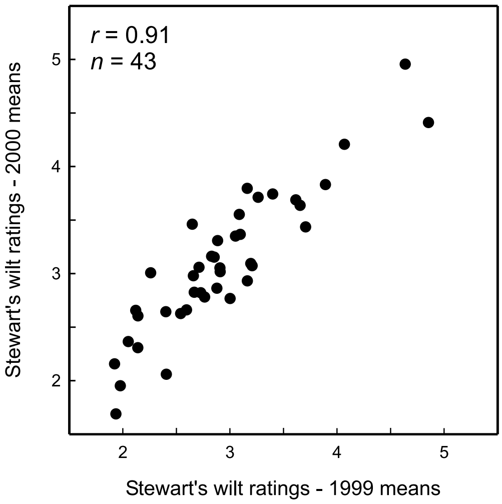

Fig. 2. Stewart's wilt ratings from 1 to 9 for maize varieties inoculated with *Erwinia stewartii* in field trials in 1999 and 2000.

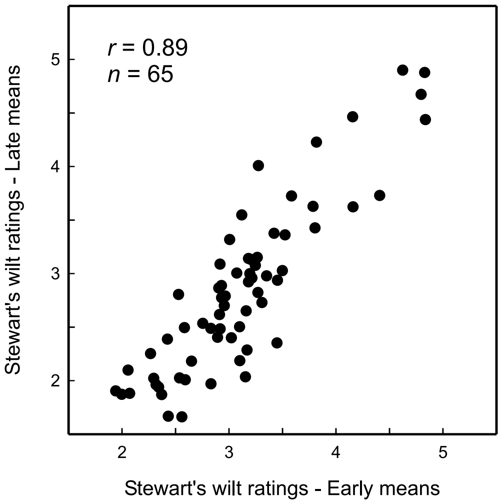

Fig. 3. Early (before pollination) and late (after pollination) Stewart's wilt ratings from 1 to 9 for maize varieties inoculated with *Erwinia stewartii* in field trials in 1999.

In 1999, early (23 June – prior to pollination) and late (23 July – after pollination) assessments of Stewart's wilt were highly correlated (Fig. 3), thus means of the two ratings were used to compare varieties. Varietal means ranged from 1.9 to 4.9 with a grand mean of 3.0 (Table 1). Stewart's wilt ratings for the S_1 generations of 25 South African varieties ranged from 2.0 to 3.9 with a grand mean of 2.8. Fifteen varieties were classified as resistant and 10 were moderate based on reactions of S_1 generations. None of the South African varieties were classified as susceptible. Stewart's wilt ratings of the commercially-available South African hybrids ranged from 2.4 to 3.2 with a mean of 2.7. Seven of the commercially available South African hybrids were classified as resistant and one was classified as moderate. Stewart's wilt ratings for food-grade, white and yellow dent maize hybrids and their S_1 generations included as controls ranged from 1.9 to 3.2 with a mean of 2.6. Ratings for sweetcorn hybrids and their S_1 generations ranged from 3.2 to 4.9 with a mean of 4.0. Variances of F_1 hybrids and their respective S_1 generations were not significantly different.

In 2000, varietal means ranged from 1.7 to 5.0 with a grand mean of 3.0 (Table 1). Stewart's wilt ratings of the S_1 generations of 19 South African varieties ranged from 1.9 to 3.8 with a mean of 3.2. Six South African varieties were classified as resistant and 13 were moderate based on reactions of S_1 generations. None of the South African varieties were classified as susceptible. Stewart's wilt ratings of the commercially available South African hybrids ranged from 2.1 to 3.2 with a mean of 2.8. Four of the commercially available South African hybrids were classified as resistant and four were classified as moderate. Stewart's wilt ratings for food-grade, white and yellow dent maize hybrids and their S_1 generations included as controls ranged from 1.7 to 3.3 with a mean of 2.8. Ratings for sweetcorn hybrids ranged from 2.9 to 5.0 with a mean of 3.8. Variances of F_1 hybrids and their respective S_1 generations were not significantly different. Ratings of F_1 hybrids and their respective S_1 generations were correlated (Fig. 4).

Greenhouse evaluation

Trials and the variety-by-trial interaction were significant sources of variation in the combined ANOVA with trials accounting for the largest proportion of the sums of squares. Stewart's wilt ratings of varieties from individual greenhouse trials were either not correlated or weakly correlated (r = –0.03 to 0.30) among trials. Stewart's wilt ratings from individual greenhouse trials and those from field trials also were not correlated or only weakly correlated (r = –0.05 to 0.45). In some instances, Stewart's wilt ratings of resistant and susceptible controls were not different in individual greenhouse trials (Table 2). In other instances, resistant controls were classified as susceptible (e.g. Bonus – March 1999 trial) or susceptible con-

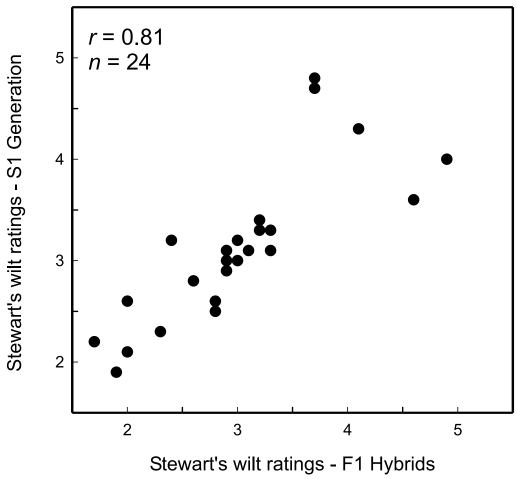

Fig. 4. Stewart's wilt ratings from 1 to 9 for sweetcorn and dent maize F_1 hybrids and their S_1 generation evaluated in field trials in 1999 and 2000.

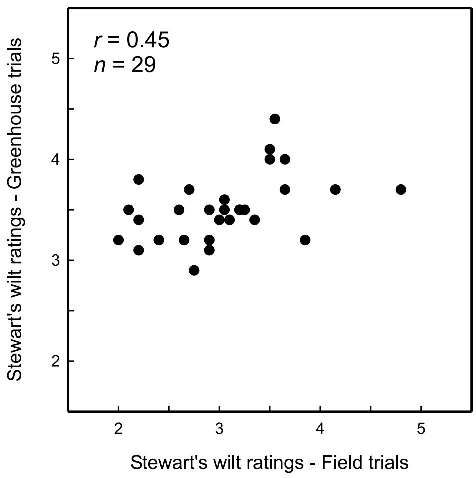

Fig. 5. Means of Stewart's wilt ratings from 1 to 9 for maize varieties inoculated with *Erwinia stewartii* in four greenhouse trials and two field trials between 1998 and 2000.

trols were classified as resistant (e.g. Jubilee – November 1999 trial). Although varieties were a significant source of variation in the ANOVA for each of the four individual greenhouse trials, results were inconsistent between trials. Therefore, it would be inappropriate to classify Stewart's wilt reactions of varieties from individual trials. However, grand means of Stewart's wilt ratings from the four greenhouse trials were weakly associated with means from the two field trials (Fig. 5).

Discussion

Stewart's wilt reactions of eight commercially-available South African maize hybrids and the S_1 generation of 25 South African maize varieties were classified as resistant or moderate based on two years of field trials in Urbana, IL, USA. Systemic Stewart's wilt infection was not observed in resistant varieties and was rare among varieties with moderate reactions. These levels of resistance are sufficient to minimise effects of Stewart's wilt on yield. Sweetcorn hybrids with similar levels of resistance have shown little or no reduction in yield when inoculated as seedlings with *E. stewartii* (Suparyono & Pataky 1989b; Freeman & Pataky 2001).

Means of sweetcorn and dent maize hybrids included as controls in field trials were not significantly different from their respective S_1 generation. Therefore, we assumed that the S_1 generation of South African varieties evaluated in field trials provided a reasonably accurate estimate of the reaction of their parental lines.

Stewart's wilt reactions of South African varieties and US hybrids included as controls were inconsistent among four greenhouse trials. Stewart's wilt ratings were poorly correlated or not correlated among greenhouse trials whereas Stewart's wilt ratings in the field trials were highly correlated. Also, control hybrids with resistant to moderate reactions to Stewart's wilt were not significantly different from control hybrids with susceptible reactions in some greenhouse trials. The variation in results from greenhouse trials may be associated partly with the relationship between growth stage at the time of infection and hybrid reaction to Stewart's wilt. When plants are inoculated in the greenhouse at very early growth stages, hybrids with resistant reactions to Stewart's wilt can become systemically infected (Michener et al. 2003). However, hybrid reactions to Stewart's wilt based on field evaluations of symptom severity (as was done in these field trials) are highly associated with the incidence of natural, systemic infection (Michener et al. 2003). Thus, field evaluations in disease nurseries such as these provide an accurate assessment of hybrid performance.

The relatively few number of plants evaluated and space constraints that limited the number of replicates in each greenhouse trial also may have contributed to variation in reactions between greenhouse trials. Regardless of the cause, the greenhouse evaluations with a limited number of replicates did not provide the same degree of

Table 2. Stewart's wilt rating from 1 to 9 for maize varieties evaluated in greenhouse trials in 1998, 1999 and 2000.

	Stewart's wilt rating and date of trial				
Variety	December 1998	March 1999	November 1999	January 2000	Grand mean
South African maize					
Border King	3.8	3.5	2.2	3.0	3.1
Carnia CRN 3414	4.0	6.6	4.0	3.0	4.4
Carnia CRN 3524	4.5	3.5	3.2	2.9	3.5
Carnia CRN 3549	3.4	3.6	3.6	3.0	3.4
Carnia CRN 3604	4.2	3.8	2.7	3.1	3.5
Carnia CRN 3631	4.0	3.7	3.4	2.6	3.4
Carnia CRN 3760	3.9	4.8	3.0	2.6	3.6
Carnia CRN 3815	3.8	3.0	3.0	2.6	3.1
Carnia CRN 3891	4.5	4.6	3.1	3.0	3.8
Hikory King	4.3	3.9	3.1	2.7	3.5
K.E.P.	3.7	4.9	3.0	2.9	3.6
MacPop 11 Popcorn	4.3	4.6	2.7	3.0	3.7
'Maize Madonella'	2.8	3.8	2.8	3.4	3.2
NS 9100 Yel. Hi. Protein	3.4	5.0	3.0	2.5	3.5
Pannar PAN 6043	3.9	4.2	3.0	2.9	3.5
Pannar PAN 6146	3.9	4.0	2.8	3.0	3.4
Pannar PAN 6243	4.3	4.5	2.9	3.0	3.7
Pannar PAN 6256	4.3	4.8	3.2	2.5	3.7
Pannar PAN 6321	3.8	4.0	2.9	2.8	3.4
Pannar PAN 6414	4.4	3.9	3.1	2.6	3.5
Pannar PAN 6471	3.4	3.1	3.5	2.8	3.2
Pannar PAN 6480	3.7	3.4	3.0	2.8	3.2
Shamrock Yellow OP	3.5	3.2	2.7	2.3	2.9
Sensako SNK 2021	4.3	3.8	3.0	1.8	3.2
Sensako SNK 2147	3.9	3.8	2.7	2.3	3.2
Sensako SNK 2151	3.1	3.1	3.1	2.5	3.0
Sensako SNK 2220	3.7	5.8	3.2	3.1	4.0
Sensako SNK 2266	3.7	4.1	3.1	3.1	3.5
Sensako SNK 2472	4.8	6.0	2.9	2.8	4.1
US hybrids					
Argent (*R/MR*)[a]	3.9	5.1	2.2	2.7	3.5
Bonus (*R*)	3.1	5.4	2.4	2.5	3.4
Dekalb DK555W (*MR*)	3.4	3.5	2.7	nd[b]	3.2
Dekalb DK631W(*MR/R*)	4.8	4.5	3.3	nd	4.2
Dekalb DK703W (*R*)	3.8	4.1	2.2	nd	3.4
Frontier (*MS*)	4.9	3.5	2.8	nd	3.7
How Sweet It Is (*M*)	nd	nd	nd	4.0	4.0
IFS 90-1 (*R*)	3.9	2.9	2.5	nd	3.1
Jubilee (*S*)	4.7	4.5	3.0	5.0	4.3
NC+ RE372W (*M*)	5.1	3.7	3.1	nd	4.0
Pegasus (*MS/S*)	nd	nd	nd	3.7	3.7
Snow White (*MS*)	5.7	4.0	3.9	nd	4.5

[a]Stewart's wilt reactions in brackets: *R* = resistant, *MR* = moderately resistant, *M* = moderate, *MS* = moderately susceptible, *S* = susceptible.
[b]nd = no data.

accuracy as field trials when Stewart's wilt reactions of maize varieties were assessed. Previous evaluations of Stewart's wilt reactions of sweet-corn hybrids in greenhouse trials with adequate replication differentiated lines with high levels of resistance from those that are highly susceptible to Stewart's wilt, although smaller differences in reactions among moderately resistant and moderately susceptible lines were not easily separated (Pataky 1985). Identification of lines that are highly susceptible to Stewart's wilt based on trials in quarantine-approved greenhouses may be useful in assessing germplasm that is at risk if *E. stewartii* is introduced to areas where it is not endemic.

Results from recent studies (Khan 1996; Block et al. 1998, 1999; Michener et al. 2002a,b) suggest that seed transmission of *E. stewartii* presents an extremely low risk of introducing the bacterium into areas where it is not endemic if seed is produced on plants with moderate or resistant reactions. Nevertheless, if *E. stewartii* were to be introduced into southern Africa, Stewart's wilt would have little impact on the performance of the varieties evaluated in this study. Furthermore, since relatively high levels of resistance to Stewart's wilt are present in these highly adapted varieties, resistance from these lines could be easily incorporated into new varieties if *E. stewartii* becomes established in southern Africa.

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