Agroforestry Systems **54**: 193–196, 2002.

A seedling inoculation test for screening *Sesbania sesban* for resistance to the seedling defoliator, *Mesoplatys ochroptera*

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Received 10 November 1999; accepted in revised form 18 July 2001

Key words: pest resistance, seedling inoculation

Abstract

The seedling beetle *Mesoplatys chroptera* is a serious pest of *Sesbania sesban* and other *Sesbania* spp. that are important agroforestry species. *Sesbania sesban* was compared to *Sesbania micrantha*, *Sesbania goetzi* and *Sesbania cinerascens*, in a seedling inoculation test for resistance to *Mesoplatys ochroptera* using copulating adult instars as inoculum. The uniform susceptibility of *Sesbania sesban* including accessions from western Kenya was confirmed. But *S. cinerascens* was found to be resistant to the pest.

Introduction

Sesbania sesban is an important species for agroforesty development in the African highlands including western Kenya where it is popular with farmers in a diversity of agro-foresty technologies (Niang et al., 1996). These technologies include fodder banks, improved fallows and scattered trees in cropland. Sesbania fallows are in addition more preferred to that of alternative species such as *Tithonia diversifolia*, because it also provides fuelwood. The utility of sesbania is however severely threatened by the sesbania defoliator beetle (*Mesoplatys ochroptera* Stahl *Chrysomilidae*). This pest can cause complete defoliation and consequent death of the tree (Melaku, 1996). Incorporation of routine insecticide sprays on farm as an integral component of the management of improved fallows is however considered an untenable proposition not only from an ecological sustainability stand point, but also because it is beyond the means of resource -poor smallscale farmers.

There is considerable variability for resistance against this pest in *Sesbania* species. In nursery screening (Melaku, 1996), observed complete defoliation and subsequent death of seedlings of *S. sesban* in the nursery. Nzioka et al. (1990) reported better field pest resistance in *S. goetzi* than in *S. sesban* though *S. goetzi* had unsatisfactory productivity, with regard to both woody and leafy biomass yields.

In laboratory or nursery screening of germplasm, resistance rating can be based on fecundity parameters in addition to parameters that are directly concerned with determination of extent of host damage (Parlevliet and Zadocks, 1977; Steinmuller, 1996), developed a petri-dish inoculation method for screening sesbania for resistance to *M. ochroptera*. But this technique is too laborious and is therefore not suited to handling large quantities of germplasm. Walyaro (1993) successfully applied seedling inoculation to selection for resistance to the Coffee berry disease pathogen, *Colletotrichum coffeanum* in *Coffea arabica*. This procedure was modified in the present study to develop a nursery seedling inoculation test for resistance to *M. ochroptera* in

S. sesban. The objective was to screen different sesbania species for tolerance or resistance to *M. ochroptera*.

Material and methods

The materials tested were part of the *S. sesban* individual tree selections of the International Center for Research in Agroforestry (ICRAF) collections derived from Western Kenya, designated as K1–K7 series where K1 etc. designates the administrative district in Western Kenya as a site of selection. The decision to concentrate screening with this germplasm was based on the fact that this material has been proven the most productive provenance in previous trials (Onim et al.; Nzioka et al. (1990)). Also included as susceptible or resistant controls were, *S. macrantha* (susceptible) and *S. goetzi* (resistant), as well as *S. keniensis* and *S. cinerescens* since their performance was not known.

Screening for resistance to *M. ochroptera*

The method employed was a random menu test in which different Sesbania accessions were offered to the pest using individual seedling randomization in a Completely Randomized Block Design with two seedlings per plot. Each replicate was enclosed in transparent light gauge polythene house constructed under a high shade netting enabling a daily maximum temperature range of 23–25 °C at 40–50% relative humidity to prevail during the trial. The one month old seedlings used had previously been pre-germinated in a sand bed following the procedure for tree nurseries as outlined by Wonyandu (1990) but pricked out into 50 cm diameter polybags. Exposure of accessions to the pest in a random menu as done here has also been used by Steinmuller in the petri-dish inoculation test of Sesbania for resistance to *Mesoplatys ochroptera*.

Inoculation was performed with natural populations of beetles from infested sesbania trees within surrounding farms using adult instars of the beetle, the females having been confirmed for readiness to oviposit by the presence of bulging ovisacs. The mature adult instars to be used were recognizable as pairs in active copulation. An inoculum concentration of 2 adult instars per seedling was applied at a 1:1 sex ratio of copulating adults (Figure 1). After inoculation, the seedlings were enclosed in polyhouse chambers to exclude beetles from the neighbourhood. The experiment was evaluated for a number of components of resistance including (1) egg laying (2) larvae number (3) leaf consumption and (4) leaf defoliation. In addition a resistance rating was done based on assessment of the whole seedling for extent of damage using a score on a scale of 0–5 at peak infestation. The resistance score was taken on each seedling and a mean grade score for a plot of two seedlings obtained. The scores were defined as follows: Seedling consumed and/or defoliated to 0%, score = 0; 10–20% = 1; 20–40% = 2; 40–60% = 3; 60–80% = 4; > 80% = 5. On each tree, eggs which were laid on the underside of the leaves were evaluated by counting with the aid of a hand lens and a hand press counter. Larval instars were counted per seedling as larvae irrespective of their size differences. Leaf consumption was determined as number of any compound leaves partially bitten off and macerated by the larvae per seedling while leaf defoliation was determined as any compound leaf which was reduced to skeletal midrib.

Results

The results are given in Table 1. The analysis of variance revealed significant differences (P = 0.05) among the entries tested. During this period egg laying could not be evaluated. In both seasons *S. cinerascens* clearly emerged the least preferred both in larvae abundance, leaf consumption as well as resistance. It was followed by *S. goetzi* which also had a significantly (P = 0.05) low preference by the beetle. All the *S. sesban* accessions were almost always uniformly susceptible in both seasons as shown by the high preference they displayed in larvae abundance, leaf consumption and resistance. A trend was however, detectable in which K1 accessions were somewhat relatively less susceptible as seen in their low larvae numbers, leaf consumption and resistance, although this difference from the other *S. sesban* accessions was non-significant (P = 0.05). The

Figure 1. Compulating adult instars of *M. ochroptera* used for inoculation.

Table 1. Resistance and susceptibility of several *Sesbania* species to infestation by the beetle *Mesoplatys ochroptera* in Western Kenya, 1997.

Parameter genotype	Leaves consumed per tree	Larvae abundance per tree	Resistance mean – grade
S. micrantha	23.1 b	5.0 bc	5.0 a
S. cinerascens	1.1 c	0.8 c	0.0 c
S. seaban K4014	29.0 ab	16.1 a	4.7 a
S. seaban K5025	44.0 a	13.5 ab	5.0 a
S. seaban K7028	26.0 ab	8.8 abc	4.0 a
S. seaban K7033	26.0 ab	9.7 abc	4.7 a
S. goetzi	12.7 bc	3.6 bc	1.7 b
C.V%	44	63	24

Notes. Values in the same column marked with same letter not significantly different DMRT ($P = 0.05$).

results of analysis of the relations between the resistance parameters, leaf consumption as well as larvae abundance and resistance rating in these materials is given (Table 2). The correlation coefficients were high and significant ($P = 0.05$) possibly indicating these parameters could be good measures of resistance.

Discussion and conclusion

The uniform susceptibility of *S. sesban* accessions has also been reported in the petri dish innocula-tion test (Steinmuller) as well as in field scores (Nzioka et al.) although in those instances, the existence of partial resistance apparent here with K1 accessions was not fount. The results indicate a high level of resistance in *S. goetzi* and an even

Table 2. Coefficients of correlation between parameters of resistance of *Sesbania* to *M. ochroptera*.

Parameter	Leaf consumption	Larvae abundance	Mean-grade
Leaf consumption		0.85*	0.84*
Larvae abundance			0.74*

* Significant at $P = 0.05$.

higher level of resistance in *S. cinerascens*. While the resistance of *S. goetzi* has previously been observed (Nzioka et al.; Otieno et al., 1990) in field scores and further confirmed in laboratory screens (Steinmuller), the resistance of *S. cinerascens* reported here for the first time, is a welcome extension of the range of the potential resistance progenitors in this species, considering the tendency of *S. cinerascens* to mutually occur naturally with *S. sesban* in similar habitats (Evans and Rtar, 1987). This would probably indicate the potential of introgressing resistance genes from *S. cinerascens* progenitors into the highly productive but susceptible *S. sesban*. These results do suggest a need for further evaluation of these material with a view to determining the genetics of resistance, its mechanism as well as the best strategy for its deployment.

In conclusion, this study shown variability in species of sesbania as well as confirmed the uniform susceptibility of *S. sesban* including material of this species collected from Western Kenya. Some level of partial resistance was apparent in *S. sesban*. The resistance in *S. goetzi* was confirmed while the high level of resistance found in *S. cinerascens* is reported for the first time and has provided an extension of the range of sources of resistance. Larvae abundance and leaf consumption were found to be useful parameters in describing resistance in nursery seedlings of sesbania.

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