

**RESISTANCE OF COWPEA VARIETIES TO
BEANFLY—*OPHIOMYIA PHASEOLI* (TRYON)
DIP: AGROMYZIDAE**

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ABSTRACT

In a field experiment carried out at Maha Illuppallama during 1985–1986 the relationship between phenotypic characteristics and beanfly infestation in six cowpea varieties was studied. It appears that varieties with smaller leaf area, small stem diameter and lower stem moisture content have greater resistance to beanfly infestation.

KEY WORDS: *Ophiomyia phaseoli*, Varietal resistance, *Vigna unguiculata*

INTRODUCTION

Cowpea (*Vigna unguiculata* L.) is one of the major grain legumes grown in Sri Lanka and its protein content is 23.1% on a dry weight basis (Chin and Yaacob, 1977). It could therefore help to bridge the protein gap in Sri Lanka where animal protein is in short supply. Cowpea could easily be cultivated because of fewer production constraints. Since its water requirement is low, it is a very good crop for the yala season in the drier parts of the country. When cowpea is cultivated extensively during the yala season, it is severely attacked by beanfly (*Ophiomyia phaseoli*). The infestation takes place during the seedling stage of the crop. Varietal resistance is considered as one of the best management practices as it could be integrated with other methods such as biological control and cultural practices, without any ill effects to either the crop or the environment.

Hundreds of varieties of cowpea, greengram and blackgram have been screened for resistance/tolerance to *O. phaseoli* at the Regional Agricultural Research Centre (RARC), Maha Illuppallama and some differences in infestation have been recorded (Subasinghe and Amarasena, 1983). But these workers have not considered plant parameters with beanfly infestation for any of these grain legumes. However, Chiang and Norris (1983) reported that beanfly infestation may be influenced by factors such as trichome

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density of the under surface of leaves, leaf area, leaf moisture content and stem diameter in a soybean crop. The present study was undertaken to determine the effect of some phenotypic and other characteristics on the resistance of cowpea varieties to beanfly (*O. phaseoli*) infestation.

MATERIALS AND METHODS

Sixteen cowpea varieties were field-screened for beanfly resistance during maha 1984/85 at RARC, Maha Illuppallama. From these, the following 6 varieties having different degree of resistance to beanfly infestation were chosen for this study:

<i>Variety</i>	<i>Degree of resistance</i>
Sudumung	Resistant
MI — 35	Intermediate
Arlington	Intermediate
Sel 230 — 2	Intermediate
VITA — 4	Intermediate
All season	Susceptible

The varieties were planted in the second week of May because beanfly population is usually very high during this time at Maha Illuppallama (Subasinghe and Amarasena, 1983). The 6 varieties were evaluated in a randomized block design with four replicates at RARC, Maha Illuppallama during the yala season of 1985 and 1986. All replicates were sited in one liyadde 2.0 m away from one another. The plot size was 2.5 m × 2.0 m. The plants received 250 kg/ha NPK fertilizer mixture (6:25:18) at planting and 30 kg/ha urea at one month after planting (Nagarajah, 1986). No pesticides were applied during the period of observation. This experiment was carried out under irrigated condition.

Several parameters were measured at the stage of (a) the first two unifoliate leaves at 7 days after emergence (DAE) and (b) the first trifoliate leaf stage at 10 DAE.

Leaf parameters at 7 DAE

Leaf thickness of the first two unifoliate leaves was measured on cross-sectional leaves. Free hand sections obtained perpendicular to the

RESISTANCE OF COWPEA VARIETIES TO BEANFLY

mid-rib of the leaf were measured using a light microscope with ocular grid ($10\times$). Leaf area of the first two unifoliate leaves was measured using a graph paper. Leaf moisture was determined by drying leaf samples at 120°C for 24 hours.

Stem parameters at 10 DAE

Plant height: Plant height from ground level to first node was measured on 10 plants per plot.

Stem diameter: Two cross-sections of each seedling were obtained, the first one, midway between the unifoliate leaves and the cotyledon, and the second midway between the cotyledon and the ground level. The diameter of each cross-sectioned internode was measured using a light microscope with an ocular grid ($10\times$). Ten seedlings were taken for this purpose.

Stem moisture content: Ten plants were uprooted from each plot. The lower portions (from ground level to cotyledon) and upper portions (from cotyledon to first internode) were separated and lengths measured before drying at 120°C for 24 hours. Moisture content was expressed in mg/cm stem length.

Beanfly infestation: Ten plants were uprooted at 7 DAE from each bed and the beanfly punctures of the two unifoliate leaves were counted. At 16 DAE, 25 plants were uprooted from each bed and dissected for beanfly larvae and pupae count. Percentage damage was obtained by counting the number of plants with beanfly larvae and pupae or both in the 25 seedlings.

RESULTS AND DISCUSSION

Beanfly infestation

During yala 1985 and yala 1986, number of beanfly punctures per leaf at 7 DAE was highest for the susceptible variety - All season and lowest for the resistant variety - Sudumung. The other varieties had intermediate values for this parameter (Table 1). The larvae plus pupae population per plant at 16 DAE also followed the same trend during these seasons (Table 1). There was also a very good positive correlation ($r=0.96$ for yala 1985 and $r=0.91$ for yala 1986) between the number of beanfly punctures per leaf at

7 DAE and the larvae+pupae population at 16 DAE. Such a relationship would be useful in establishing economic threshold levels for beanfly infestation for the implementation of an integrated pest management programme for cowpea.

Phenotypic characteristics

Plant height, leaf thickness, leaf area and stem diameter were measured during yala 1985 and 1986. Since these parameters followed similar trends during these two seasons only the data obtained during yala 1985 when beanfly population was high, are discussed.

Plant height: Although cowpea varieties had significantly different plant heights at 7 DAE (Table 2) it was not related to the level of beanfly infestation.

Leaf thickness: Although leaf thickness varied with the varieties there was no significant relationship with damage by beanfly (Tables 2 and 3). Similar result was obtained for soybean by Chiang and Norris (1983).

Leaf area: Leaf area of the susceptible variety-All season was significantly higher than the other varieties; but there was no significant differences among the other varieties (Table 2). According to Spencer (1973) beanfly eggs are usually concentrated near a vein although they can also occur in other parts of the leaf blade. Since a large leaf has a bigger area involving veins, it (a large leaf) is likely to have more sites for oviposition than a smaller leaf. In the present study this seems to be the case, because during both yala seasons beanfly punctures per leaf and larvae plus pupae population were high for the large leaf area variety-All season and low for the small leaf area variety-Sudumung (Tables 1 and 2). This is further supported by the positive and significant correlation between area of first two leaves and the number of beanfly punctures per leaf ($r=0.84$) during yala 1985. However, this correlation was not significant ($r=0.75$) in yala 1986 (Table 3). This may be related to the higher beanfly population during yala 1985. Chiang and Norris (1985) also found a similar relationship between leaf size and beanfly infestation for soybean.

Stem diameter: Stem diameter of the susceptible variety-All season was significantly higher than all the other varieties (Table 2). The resistant variety, Sudumung and the intermediate resistant variety, MI-35 recorded

RESISTANCE OF COWPEA VARIETIES TO BEANFLY

the lowest value. According to Spencer (1973) *O. phaseoli* mines through the cortical layer under the epidermis of the plant stem. Compact stem as in the resistant variety can therefore hinder the activity of the third instar larvae. The good positive correlation between stem diameter (at the base of the plant) and the level of beanfly infestation both in yala 1985 and 1986 (Table 3) seems to support the above hypothesis. Chiang and Norris (1985) also reported a similar relationship in soybean.

Stem moisture

The stem moisture content (both lower and upper) was lowest for the resistant variety, Sudumung and highest for the susceptible variety, All season. The other cowpea varieties had intermediate values (Table 2). Beanfly infestation as measured by larvae+pupae population and stem moisture content gave a positive correlation (Table 3). Similar relationship between stem moisture content and level of beanfly infestation had also been reported in soybean (Chiang and Norris, 1983). Thus it appears that cowpea varieties with lower stem moisture content provide an unfavourable host-plant environment for beanfly larvae and vice versa. Low moisture content of the resistant variety, Sudumung can be related to the compactness of the stem. Probably this compactness may be attributed to the rate of sclerenchyma differentiation (involving completion of the secondary cell wall and lignification) in the stem cortex as in the case of soybean (Chiang and Norris, 1985).

CONCLUSION

It appears that beanfly infestation in cowpea could be minimized by growing varieties resistant to this pest. This study shows that cowpea varieties possessing smaller leaf area, smaller stem diameter and lower stem moisture content may have greater resistance to beanfly infestation.

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Table 1. Beanfly infestation on six cowpea varieties at 7 and 16 DAE

Variety	Season			
	yala 1985		yala 1986	
	Beanfly punctures per leaf	Number of larvae + pupae per plant	Beanfly punctures per leaf	Number of larvae + pupae per plant
	7 DAE	16 DAE	7 DAE	16 DAE
Sudumung	6.9 d	0.44 d	6.5 d	0.40 c
M1 — 35	9.9 c	0.88 c	9.3 c	0.78 b
Arlington	10.5 bc	0.86 c	10.2 bc	0.81 b
Sel — 230 — 2	11.0 bc	0.56 d	10.6 bc	0.49 c
VITA — 4	12.1 b	1.07 b	11.9 bc	1.00 a
All season	18.1 a	1.48 a	16.5 a	1.40 a

Means followed by the same letter are not significantly different at $p = 0.05$ by Duncan's Multiple Range Test (DMRT)

RESISTANCE OF COWPEA VARIETIES TO BEANFLY

Table 2. Comparison of some leaf and stem parameters of cowpea varieties (yala 1985)

Variety	7 DAE			10 DAE			
	Leaf area (cm ²)	Leaf thickness (mm)	Leaf moisture (%)	Plant height (cm)	Stem moisture (lower) (mg/cm)	Stem moisture (upper) (mg/cm)	Stem diameter (mm)
Sudumung	12.12 b	0.76 a	84.1	7.89 b	22.9 d	34.7 d	1.98 cd
MI-35	9.43 b	0.78 a	86.3	6.34 d	29.6 bc	38.8 c	1.93 d
Arlington	10.75 b	0.78 a	85.2	7.23 c	30.3 bc	54.0 b	2.15 c
Sel-230-2	9.78 b	0.66 b	85.3	6.24 d	28.5 cd	41.8 c	2.08 cd
VITA-4	10.39 b	0.76 a	85.1	7.90 b	35.0 b	51.8 b	2.35 d
All season	28.68 a	0.56 c	86.7	9.68 a	59.0 a	74.1 a	2.58 a
CV (%)	19.9	12.1	16.6	8.2	9.3	10.0	11.7

Means followed by the same letter are not significantly different at $p=0.05$ by DMRT

Table 3. Relationship between some leaf and stem parameters and the level of beanfly infestation in cowpea seedlings

Relationship	Season	Correlation coefficient
No. of larvae + pupae per plant vs stem diameter	yala 85	$r = 0.858^*$
	yala 86	$r = 0.826^*$
No. of larvae + pupae per plant vs stem moisture (lower)	yala 85	$r = 0.935^{**}$
	yala 86	$r = 0.928^{**}$
No. of larvae + pupae per plant vs stem moisture (upper)	yala 85	$r = 0.905^*$
	yala 86	$r = 0.964^{**}$
Beanfly punctures per leaf vs leaf area	yala 85	$r = 0.836^*$
	yala 86	$r = 0.753$
% damage vs leaf thickness	yala 85	$r = 0.572$
	yala 86	$r = 0.460$

* Significant at $p = 0.05$

** Significant at $p = 0.01$