NATIONAL SEMINAR ON BREEDING CROP PLANTS FOR RESISTANCE TO PESTS AND DISEASES

May, 25-27, 1983.

SCHOOL OF GENETICS
TAMILNADU AGRICULTURAL UNIVERSITY
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A Suggested System of Rating Pigeon Pea and Chick Pea Entries for Field Resistance to Heliothis Armigera.

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Abstract

To deal with the seasonal and year to year variation in the intensity of infestation by *Heliothis armigera* in pigeonpea and chickpea, a method of grading test materials based on pest damage are is suggested. On the basis of this grading, the test meterials are rated for their relative susceptibility.

Introduction

Plant resistance susceptibility to insect pests is detected normally by counts or estimates, of insect population, or of damage caused by the insects in the plants. In open field screening, where natural pest population is relied upon to indicate differences in susceptibility, the numbers of insects present in each plant, and the extent of damage caused, will be a function of the genetic resistance/ susceptibility of that plant, the size of the plant, climatic factors and the population of insects available to infest the plant- The population of the insect pests that are available will vary greatly, both in space and time.

At ICRISAT Center in screening pigeonpea germplasm for resistance to *Heliothis armigera* it was observed that due to wide variation in the pest population year to year the percentage of pods damaged ranged from 10 to 100 percent. With such variability, the concept adopted by Entomolegists in general that a resistant plant is one on which pest damage dees not exceed 10 percent is to be reconsidered. Under heavy pest load. it is very hard to locate plant sources that will record less than 10 percent infestation

In this background, a method to test matarials for resistance to *H. armigera* is suggested.

The following definition of plant resistance to insect pests was prepared by an Internationl committee that met for the purpose of establishing an accurate definition. (Glalun and Ortman, 1978.)

"Resistance is the consequence of heritable plant qualities that result in a plant being relatively less infested or damaged than a susceptible plant without these qualities. Resistance of plants is based on a comparison with plants which are severely damaged or infested (usually susceptible) under the same set of conditions. Degrees or levels can be quantified then qualified by the use of such terms as high, intermediate or low"

This definition clearly indicates that resistance is subjective, and not related to the absolute level of pest incidence or damage on a plant.

Resistance screening at ICRISAT

The two major pests in pigeonpea are the pod borer, *Heliothis armigera* and the podfly *Melanagromyza obtusa*. Sheritff and Rajagopalan (1971) reported the influence of the timing of flowering and maturity of pigeonpea cutivars on the levels of damage caused by the insectpests, particularly by podfly. At ICRISAT Center, early and mid-maturity cultivars flower and pod from September to November when *Heliothis* populations are high but at this paried the podfly population is low. The late maturing cultivars form pods in January-February, when they are subject to much lower infestation by *Heliothis*, but greater damage by podfly. The relative damage caused by these varying pest populations is well illustrated by means of pod damage records from trials containing cultivars of differing maturity groups conducted for the All India Coordinated Pulse Improvement Project at ICRISAT Center in 1982-83 (Table 1)

Table 1. Mean percentages of pigeonpea pods damaged by the major insect pests in AICPIP trials conducted at ICRISAT Center 1982-83.

Cultivar maturities		(Pod damage %)	
		Pod borer	Podfly
Extra early	12	41.8 + 1.17	2.4 + 0.15
Early-Mid	6	53 3 + 2.54	6.3 + 6.87
Mid	12	93.4 + 0.67	3.7 + 0 27
Late	8	24.2 + 0.94	25.6 + 1.18

The data in Table 1 are typical of those obtained at ICRISAT during the past 7 years, with *Heliothis* damage being greatest on the mid maturity cultivars and podfly damage being most severe on the late maturing cultivars. However, these data do not indicate that the mid maturity cultivars have the greatest genetic susceptibility to the pod borer nor that they are more resistant to podfly than the late maturing cultivars. These mean damage data reflect the populations ot pests available in the fields at the vulnerable stage of the crops. These facts prevent us from usefull/ comparing the resistance/susceptibility of genotypes that differ greatly in their time of flowering/maturity in a trial, for they will be subject to very different levels of pest attack.

To overcome this problem we have developed a method of screening genotypes in separate trials, each containing a very narrow range of maturities. In each trial we include a "check" cultivar of the appropriate maturity. Wherever possible the check is a well known cultivar that is widely used and so is unlikely to be highly susceptible to pests. We compare the percentage of pod damage at maturity of any test entry with that of the check in the trial. The test entries are then graded using a formula derived from Abbott (1925):-

$$\text{Pest susceptibility percentage} = \frac{\text{P. D. of check} - \text{P. D. of test entry}}{\text{P. D. of check}} \times 100$$

where P. D. = mean percentage or pods damaged

The pest susceptibility percentage is then conyerted to a 1 to 9 rating (Reed and Lateef, 1980) adopting the following scale :

Susceptibility Rating	*Pod Damage (%)*
1	100%
2	75%
3	50% to 75%
4	25% to 50%
5	10% to 25%
6	— 10% to 10%
7	— 25% to — 10%
8	— 50% to — 25%
9	— 50% or less

An example of the use of such rating is shown in Table 2. It can be seen that low ratings for *Heliothis* are often associated with high ratings for podfly.

Table 2: Rating of pigeon pea cultivars for resistance to pod borer and pod fly

Entry	Pod Borer damage %	Susceptibility rating	Podfly damage (%)	Susceptibility rating
ICP-3009-E 3	27.3	4	2.9	6
ICP-10466-E 1	30.7	4	2.4	5
ICP-1811-E 1	24.2	3	2.9	6
ICP-3615-E 1	17.7	3	18.4	9
ICP-7946-E 1	33.5	4	4.3	8
ICP-8325-E 1	24.7	3	14.3	9
ICP-4307-E 3	35.4	4	6.2	9
ICP-8102-5-Slo-EB	16.9	3	14.9	9
ICP-8583-E 1	10.3	2	14.9	9
ICP-7745-E 1	38.7	5	6.9	9
ICP-7050-E B	31.8	4	11.0	9
ICP-2223-1-E B	15.4	3	2.1	4
PPE-37-3	9.6	2	20.2	9
ICP-5036-E 1	14,0	3	18.3	9
GW-3-3 EB	12.2	2	13.5	9
PPE-36-2	9.6	2	21.7	9
ICP-7337-2-S4-EB	11.0	2	41.3	9
C-11 (Check)	49.2		3.0	

By using these ratings we can compare the resistance/susceptibility of any genotypes across areas or years even though they may be subject to greatly varying levels of pest attack. It must be emphasised that a low rating in one trial will not be good evidence of resistance, even though the data are obtained from a replicated trial, for coefficients of variation are usually high in such trials and some entries may escape damage for several reasons. At ICRISAT we require consistently low ratings from 3 years of testing before we are satisfied that any genotype has genetic resistance. An example of such consistancy in our screening for resistance to *Heliothis* in chickpea is shown in Table 3. Here ICC-506 is clearly more resistant than the common check of the same maturity.

Table 3: Resistance in tw ochickpea entries to *armigera*

	1978/79		1979/80		1980/81		1981/82	
	P. D,	R	P. D.	R	P. D.	R	P. D.	R
ICC-506	8.0	3	5,7	3	5.1	3	5.2	3
Annigeri (Check)	31.2	6	15.8	6	20.0	6	15.4	6
S. E. (m) ±	1.73		1.64		1.70		1.51	

P. D. = Percentage of pods damaged; R = Susceptibility rating on 1-9 scale.

Acknowledgement

We acknowledge the assistance rendered by the technical staff of the Pulse Entomology Research Progrom, ICRISAT.

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