# INHERITANCE OF RESISTANCE TO YELLOW MOSAIC IN MUNGBEAN+

G. P. SHUKLA*, B. P. PANDYA and D. P. SINGH

*Department of Plant Breeding, G. B. Pant University of Agriculture and Technology, Pantnagar, India*

AMONG all the diseases affecting mungbean [*Vigna radiata* (L.) Wilczek] yellow mosaic caused by mungbean yellow mosaic virus (MYMV) is the most devastating disease This has become increasingly serious because of the lack of resistance in the varieties cultivated by the farmers. Mungbean plants infected with yellow mosaic virus had very few flowers and pods, pods were curled and reduced in size, seeds were reduced in size and the percentage of shrivelled seeds was increased (Nariani, 1960; Nene, 1969). Yield losses upto 85 per cent have been recorded (Nair, 1971). Nariani (1960) reported that the virus is transmissible by whitefly (*Bemisia tabaci* Genn).

This investigation was undertaken to study the inheritance of resistance to mungbean yellow mosaic virus mungbean.

## MATERIALS AND METHODS

Six indigenous varieties of mungbean used in the present study were: 'Tarai Local' (resistant), 'L-80' (moderately resistant), 'L-294-1' and 'LM-214' (tolerant), 'Jawahar-45' and 'G-65' (susceptible). The first four were from germplasm while the later two are released for cultivation to farmers. All the 6 parents, 8 $F_1$'s, their $F_2$ and $F_3$ generations were grown in 1976, wet season. The row to row and plant to plant spacing was 50 and 10 cm, respectively. The row length was 5 m. 'Kargaon-3', a highly yellow mosaic susceptible cultivar of urd (*Vigna mungo* (L.) Hepper) was used as infector and was planted after each 2 rows to intensify MYMV inoculum from natural sources. No chemical was sprayed in order to maintain the natural whitefly population in the field. Furthermore, for proper inoculation plants were inoculated artificially with the insect vector whitefly (*Bemisia tabaci* Genn.). The equipment used for collection and transfer of whiteflies was the same as designed by Rathi (1972). A slight modification in the aspirator was done to hasten the collection of whiteflies. The brasswire mesh and the rubber tubbing were removed so that the insects were collected inside the bottle rather than in the glass tube inself.

For acquisition feeding, whiteflies were collected from field and were released after a period of 3 to 4 hrs. of starvation into insect proof, transparent plastic pickle pots with screwcap (Nene, 1972) and were fed on diseased plants for 20 to 24 hrs. The viruliferous flies were then transferred to other cages to feed on 20 to 40 days old plants for inoculation of the virus. In each cage 8 to 10 viruliferous flies were allowed to feed for a period of 3 to 4 hrs. for effective transmission of the virus. This method was followed for inoculating the parents and hybrids. However, for inoculating $F_2$ and $F_3$ generations, transmission cages of 120 × 80 × 60 cm dimension were used (Nene, 1972). The cages were made by stretching muslin cloth on an iron frame. About 15–20 plants were enclosed in these cages and were inoculated simultaneously by releasing 200 viruliferous whiteflies for 3 to 4 hrs.

The disease score was recorded 3 weeks after inoculation. The disease rating was done on 1-9 scale, where 1=completely free (resistant); 3=traces of necrotic mottle (moderately resistant); 5=

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*Present Address: Indian Grassland and Fodder Research Institute, Jhansi-284 001 ((U.P.).

moderate necrotic mottle (tolerant); 7=restricted yellow mottle (moderately susceptible); 9=complete yellow mottle (susceptible). The mean disease score was calculated as Σ (infection rate × frequency)/ number of plants.

The individual plants were scored in the parents, $F_1$'s and F2 generations. The $F_2$ data from the crosses involving moderately resistant/tolerant and susceptible parents were classified into resistant (1 to 5 score) and susceptible (7 and 9 score), while the $F_2$ plants from resistant × susceptible crosses were classified as resistant (1 score) and susceptible (other scores). The $F_3$ progenies were classified as segregating and non-segregating resistant or susceptible.

## Results and Discussion

The total number of plants, mean disease score and disease reaction of parents and hybrids is presented in Table 1. In all the crosses involving a susceptible ('Jawahar-45' and 'G. 65'), and a resistant ('Tarai Local'), moderately resistant ('L-80'), tolerant ('L 294–1' and 'LM-214) parent, susceptibility was dominant (Table 1). Susceptibility dominant over resistance has also been reported for MYMV in soybean (Malick, 1976), bean yellow mosaic virus (Reeder *et al.*, 1972), cowpea chlorotic mottle virus (Roger *et al.*, 1973) in cowpea, bean yellow mosaic virus and watermelon mosaic virus 2 (Schroeder and Provvidenti, 1971) and bean yellow mosaic virus in interspecific crosses of *Phaseolus vulgaris* × *P. coccineus* (Baggett, 1956).

Table 1

*The disease reaction of parents and hybrids*

| Parents/Hybrids | Total number of plants tested | Mean disease score | Disease reaction |
|---|---|---|---|
| Tarai Local | 344 | 1·064 | Resistant |
| L–80 | 164 | 2·439 | Moderately resistant |
| L–294–1 | 221 | 3·290 | Tolerant |
| LM–214 | 295 | 3·820 | Tolerant |
| Jawahar–45 | 235 | 7·826 | Susceptible |
| G–65 | 228 | 8·728 | Susceptible |
| Jawahar–45 × Tarai local | 33 | 6·455 | Mod. Susc. |
| G–65 × Tarai local | 17 | 5·706 | Mod. Susc. |
| Jawahar–45 × L–80 | 70 | 7·457 | Susceptible |
| G–65 × L–80 | 94 | 7·680 | Susceptible |
| Jawahar–45 × L–294–1 | 38 | 7·789 | Susceptible |
| G–65 × L–294–1 | 61 | 7·787 | Susceptible |
| Jawahar–45 × LM–214 | 64 | 7·719 | Susceptible |
| G–65 × LM–214 | 50 | 7·640 | Susceptible |

The $F_2$ population from all the crosses showed a digenic duplicate factor interaction (Table 2). The segregation in the ratio of 15 (susceptible); 1

TABLE 2

*Segregation for resistance to yellow mosaic virus in $F_2$ and $F_3$ generations under artificial testing*

| Cross and generation | | Segregation | | | Expected genetic ratio | P between |
|---|---|---|---|---|---|---|
| | | Susceptible | Segregating | Resistant | | |
| Jawahar-45 × Tarai Local | ($F_2$) | 15 | — | 5 | 15:1 | ·01–·001 |
| | ($F_3$) | 14 | 18 | 3 | 7:8:1 | ·98–·95 |
| G-65 × Tarai local | ($F_2$) | 190 | — | 10 | 15:1 | ·70–·50 |
| | ($F_3$) | 19 | 28 | 3 | 7:8:1 | ·80–·70 |
| Jawahar-45 × L-80 | ($F_2$) | 160 | — | 5 | 15:1 | ·20–·10 |
| | ($F_3$) | 9 | 9 | 1 | 7:8:1 | ·98–·95 |
| G-65 × L-80 | ($F_2$) | 171 | — | 11 | 15:1 | ·98–·95 |
| | ($F_3$) | 13 | 24 | 1 | 7:8:1 | ·50–·30 |
| Jawahar-45 × L-294-1 | ($F_2$) | 410 | — | 34 | 15:1 | ·30–·20 |
| | ($F_3$) | 18 | 26 | 2 | 7:8:1 | ·80–·70 |
| G-65 × L-294-1 | ($F_2$) | 372 | — | 24 | 15:1 | ·98–·95 |
| | ($F_3$) | 6 | 10 | 0 | 7:8:1 | ·80–·70 |
| Jawahar-45 × LM-214 | ($F_2$) | 566 | — | 36 | 15:1 | ·90–·80 |
| | ($F_3$) | 21 | 28 | 1 | 7:8:1 | ·70–·50 |
| G-65 × LM-214 | ($F_2$) | 387 | — | 36 | 15:1 | ·10–·05 |
| | ($F_3$) | 17 | 29 | 4 | 7:8:1 | ·50–·30 |

(resistant) was observed in $F_2$. In the cross of 'Jawahar-45' and 'Tarai Local' the P value was low (0·01—0·001) which could be because of small population size. However, the $F_3$ progenies segregation showed that two recessive genes were involved. The $F_3$ progenies from all the crosses showed (Table 2) a segregation pattern of 7 (non-segregating susceptible): 8 (segregating) :1 (non-segregating resistant). The results of the $F_3$ segregation confirmed the segregation pattern of $F_2$ generation. The double recessive inheritance of reistance has also been observed by Malick (1976) in soybean and for some virus like abnormalities in snapbean (Baggett and Frazier, 1957). However, one major recessive gene has been reported for different viral diseases of grain legumes (Reeder *et al.*, 1972; Roger *et al.*, 1973 and Drijfhout, 1968).

The varieties in the present study were different with respect to their disease reaction but the segregation pattern in the $F_2$ and $F_3$ generation was same and in the $F_1$ susceptibility was dominant. This indicated that the genes for resistance in these varieties are different (Shukla, 1977). It is also suggested that in a breeding programme for resistance to MYMV a large population must be grown to recover enough resistant plants.

SUMMARY

The inheritance of resistance to yellow mosaic virus was studied in mungbean [*V. radiata* (L.) Wilczek]. The parents, 'Tarai Local' (resistant), 'L-80' (moderately resistant), 'L 294–1' and 'LM-214' (tolerant) and 'Jawahar-45' and 'G-65' (susceptible), their $F_1$'s, $F_2$ and $F_3$ generations were inoculated artificially. The resistance was found to be under digenic control and recessive in all the crosses.

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