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# Mutants resistant to foliar diseases in groundnut (*Arachis hypogaea* L.)

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**Foliar diseases particularly leafspots and rust are the major factors limiting yield and quality in groundnut. Most of the groundnut cultivars in India are highly susceptible to foliar diseases. Fungicidal sprays are effective in controlling these diseases, but the use of disease-resistant cultivars is a better approach. A number of resistant germplasm lines are available but many other undesirable attributes limit their utility as cultivars. Attempts have been made to produce high yielding disease resistant cultivars through hybridization, but the lines developed either had only moderate resistance or retained one or more undesirable features. Mutagenic treatment of Valencia 1 with EMS, resulted in isolation of a large number of foliar disease-resistant mutants. Three mutants, viz. 28-2, 45 and 110 combined high yield potential and early maturity, besides multiple disease resistance and desirable pod and kernel features. These mutants can be widely tested for their commercial release and/or profitably utilized in future breeding programmes.**

THE cultivated groundnut (*Arachis hypogaea* L.) is an important oilseed crop and is presently cultivated in an area of 21.17 m ha with a total production of 25.89 m t. In India groundnut occupies 31.3 per cent of the total cropped area under oilseeds (8.35 m ha) and accounts for 36.1 per cent of total oilseed production (8.85 m t). Like in other developing countries, the average yield in India is around 1000 kg per ha as against the average of 2995 kg per ha realized in USA[1]. Many reasons are ascribed to the low productivity in developing countries. Foliar diseases particularly early leafspot (*Cercospora arachidicola* Hori.), late leafspot (*Phaeoisariopsis personata* (Berk and Curt) V. Arx) and rust (*Puccinia arachidis* Speg.) are the major factors limiting yield and quality in groundnut. Each of these diseases is individually capable of causing substantial yield loss, and when leafspots and rust occur together yield losses can go up to 70 per cent[2]. These diseases have an adverse influence on the recovery of pods at harvest, quality of seeds, and haulms. Fowler[3] estimated that defoliation of leaflets may begin when six per cent of their leaf area is diseased. Severe infections may cause complete defoliation. However, lesions are not confined to the leaves but may occur also on the stems and pegs, leading to direct deterioration of the developing pods[4]. Because of prolonged wet periods, late leafspot is more predominant in the transitional belt of Karnataka, which accounts for over 50 per cent pod and fodder yield loss[5]. Spanish cultivars are the most popular cultivars in this regions as they mature early and facilitate double cropping under rainfed conditions. But all of them are highly susceptible to the foliar diseases. Though several effective chemicals are available to control these diseases, fungicidal control is not preferred due to the escalation of production cost, especially in the rainfed condition[6]. Cultivation of the resistant/tolerant varieties is the best approach under these circumstances.

Several genotypes resistant to late leafspot and rust have been identified. But most of them belong to the Valencia group and are landraces with a number of undesirable attributes like thick shell, low productivity, late maturity and poor adaptation, making them unsuitable for direct utilization[7,8]. A number of attempts have been made to produce disease-resistant, productive cultivars through hybridization, but the lines developed either possessed only a moderate level of resistance or retained one or more undesirable features[9]. A number of wild *Arachis* species have shown either highly resistant or immune reaction to these pathogens[10]. *A. cardenasii*, a diploid species, was identified to be an excellent source of resistance to late leafspot[9]. Stable interspecific hybrid derivatives belonging to *Virginia* group with high yield and high level of resistance have been developed but they were all late maturing and had low shelling percentages[11]. Recently two moderately resistant hybrid derivatives, viz. ICGV 86590 and ICGV 87160 were released for commercial cultivation in southern peninsular region of India. They are comparable to popular susceptible cultivar JL 24 in productivity, but suffer from

**Table 1.** Performance of mutants for resistance to foliar diseases, productivity and pod and kernel features

| Genotype | Botanical type | Field disease# score (1–9 scale) Leaf-spots | Rust | Cumulative AUDPC | Pod yield (g/plant) Pr | UPr | Mean (MP) | Shelling percentage (UPr) | SSI | Days to maturity | Pod features† Beak | Constri-ction | Reti-culation | Kernel‡ colour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parents | | | | | | | | | | | | | | |
| DER | * | 9 | 7 | 2069$^{c}$ | 23.1$^{c}$ | 11.4$^{g}$ | 17.3$^{c}$ | 74.1$^{a}$ | 6.0 | 97 | S | P | S | LT |
| VL1 | Valencia | 9 | 2 | 1911$^{d}$ | 30.4$^{c}$ | 19.3$^{f}$ | 24.9$^{d}$ | 70.3$^{c}$ | 8.6 | 103 | A | A | A | DT |
| Selected mutants | | | | | | | | | | | | | | |
| 28-2 | Spanish | 5 | 2 | 732$^{a}$ | 39.7$^{a}$ | 36.4$^{a}$ | 38.1$^{a}$ | 74.0$^{a}$ | 1.2 | 102 | A | M | A | DT |
| 45 | Spanish | 5 | 3 | 766$^{a}$ | 36.9$^{ab}$ | 34.2$^{b}$ | 35.6$^{b}$ | 72.5$^{b}$ | 1.3 | 102 | A | M | A | DT |
| 110 | Spanish | 5 | 8 | 842$^{ab}$ | 32.4$^{c}$ | 31.0$^{c}$ | 31.7$^{c}$ | 72.6$^{b}$ | −0.8 | 102 | A | M | A | DT |
| Susceptible check | | | | | | | | | | | | | | |
| JL 24 | Spanish | 9 | 8 | 2122$^{c}$ | 38.8$^{ab}$ | 25.9$^{d}$ | 32.4$^{c}$ | 74.3$^{a}$ | 8.5 | 100 | S | S | A | DT |
| Resistant checks | | | | | | | | | | | | | | |
| GBFDS 272 | Virginia | 5 | 2 | 790$^{ab}$ | 26.9$^{d}$ | 24.0$^{c}$ | 25.5$^{d}$ | 74.9$^{a}$ | 1.9 | 125 | M | M | M | R |
| PI 259747 | Valencia | 5 | 2 | 993$^{c}$ | 24.9$^{d}$ | 23.3$^{c}$ | 24.1$^{d}$ | 74.1$^{a}$ | 1.2 | 118 | M | P | P | P |
| Mean of 23 genotypes | | 7.4 | 3.8 | 1463.30 | 32.25 | 25.79 | 28.99 | 72.1 | 3.77 | 104.7 | – | – | – | – |
| S.Em. | – | – | – | 21.63 | 3.34 | 0.52 | 0.72 | 0.44 | – | – | – | – | – | – |
| LSD (5%) | – | – | – | 63.43 | 2.11 | 1.52 | 2.06 | 1.29 | – | – | – | – | – | – |

Figure(s) with same subscript(s) do not differ at 5% level of significance.
*Cannot be grouped in any of the four botanical types.
Pr = Fungicide protected and UPr = Unprotected diseased condition.
†Pod features: A – Absent, S – Slight, M – Moderate, P – Prominent.
‡Kernel colour: LT – Light tan, DT – Dark tan, P – Purple, R – Red.
#Field disease score: where 1 = 0%, 2 = 1–5%, 3 = 6–10%, 4 = 11–20%, 5 = 21–30%, 6 = 31–40%, 7 = 41–60%, 8 = 61–80% and 9 = 81–100% damage to foliage.

low shelling outturn, undesirable pod features besides slightly late maturity[12]. Hence, there is a strong need to develop and identify new germplasm combining high level of resistance, early maturity, desirable pod and kernel features, besides increased productivity in groundnut. But the information so far available points to the existence of a yield/resistance barrier[13].

Induced mutagenesis offers an opportunity to artificially create desirable variation. Artificial mutagenesis of Dharwad Early Runner (DER), a stable genotype, with ethyl methane sulphonate (EMS) in our laboratory yielded resistant, early maturing, and erect bunch Valencia mutants (viz. 1, 2, 8, 26, 39, 59 and 83)[14]. On subsequent mutagenesis with EMS, mutant-1 (VL 1) yielded secondary mutants (28-2, 45 and 110), which showed a high level of resistance with more desirable attributes[15].

In the present study, 18 induced mutants were evaluated for foliar diseases reaction, productivity, and pod and kernel features along with DER and VL 1 parents and susceptible (JL 24) and resistant (PI 259747 and GBFDS 272) checks under both fungicide protected (Pr) and unprotected (UPr) diseased conditions. The experiment was conducted during the 1995 rainy season in a split plot design with two replications. The main plots consisted of two treatments, viz. (i) As a fungicidal treatment carbendazim (@0.05%), tridemorph (@0.05%) were sprayed to control leafspots and rust respectively at 60, 75 and 90 days after sowing. (ii) As a no fungicide check treatment water was sprayed at the rate of 500 l/ha. The sub-plots comprised of 23 genotypes. Each genotype, except DER, was grown in a 2 m row with a spacing of 30 cm between rows. The plant to plant distance within a row was 10 cm. In the case of DER line spacing was 60 × 15 cm owing to its procumbent habit. In each replication, all the observations were made on the five randomly selected plants. Each genotype was scored one week before harvest of the crop for leafspots and rust on a 1–9 scale[16]. The data collected on leaf area affected due to leaf spots and rust and defoliation at five stages (70, 77, 84, 91 and 98 days after sowing) were used to compute total leaf area lost at different stages. From these data cumulative AUDPC (Area under disease progress curve), an overall indicator of disease resistance was calculated[17]. Mean productivity (MP) represented by the average yield under disease protected and non-protected conditions and stress susceptibility index (SSI)[18] were used as criteria for assessing genotypes for diseases tolerance. The genotypes with higher MP and lower SSI were considered as productive and tolerant. After harvesting pods were washed, and dried, pod yield per plant (g) and shelling percentage were determined. Pod (beak, constriction and reticulation) and kernel (colour) features were recorded as per the descriptor published by IBPGR[19].

As indicated by the field disease scores and cumulative AUDPC values, the incidence of leafspots and/or rust was significantly lower in the mutants than the susceptible

**Figure 1.** Disease development on parents (DER and VL 1) and selected mutants.


**Figure 2.** Pod and kernel features of susceptible cultivars (TMV 2 and JL 24), resistant germplasm (PI 259747 and GBFDS 272), resistant cultivars (ICGV 86590 and ICGV 87160) and selected mutants (28-2, 45 and 110).

check and parents (Table 1 and also Figure 1). The resistant Spanish mutants (28-2, 45 and 110) matured early (103 days) compared to resistant checks. They also had desirable pod and kernel features, viz. smooth pods and tan kernels (Figure 2) and were comparable to susceptible check (JL 24) for yield and shelling outturn. They also recorded lower stress susceptibility index and higher mean productivity (Table 1). These mutants can be widely tested for their commercial release and/or profitably utilized in future breeding programmes.

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