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SELECTION SYSTEMS FOR LATE LEAFSPOT RESISTANCE IN GROUNDNUT (*Arachis hypogaea* L.)

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Abstract- Single and multiple crosses advanced from S1 to S3 generation by three selection schemes such as scheme I (single seed bulk), scheme II (selection for yield and resistance) and scheme III (selection for only resistance).Different types of selection schemes along with crosses have shown large amount of variability for pod yield and resistance attribute like leaf area affected and defoliation. Breeding methods did not differ much for heritable variation. Among the different breeding methods employed scheme I retained higher variability for productivity attributes and scheme III for resistance components. The material forwarded through scheme I and II gave higher frequency of desirable recombinants than scheme III. However, scheme II involved additional cost and efforts as compared to single seed descent method. Based on the results a comprehensive breeding approach for developing disease resistant and productive cultivars has been discussed.

Keywords- Groundnut, Late leafspot, Resistance, Selection systems, Productivity, Comprehensive breeding strategy.

Introduction

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. Usually in India all these diseases occur together causing yield losses up to 70% [4]. But late leafspot is more prevalent and damages the plant by reducing the available photosynthetic area by lesion formation finally stimulating leaflet abscission leading to extensive defoliation and hence affecting both quantity and quality of haulms. 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. Early generation testing for yield and other characters is an alternative method to accelerate generation advance, which considerably reduces the cost of the whole improvement programme by reducing the input of labour and management. Acceptable breeding lines were selected by using early generation trials in groundnut [3]. The objective of the present study is to evaluate suitability of selection schemes in early generation for producing productive segregants with resistance to late leafspot and desirable agronomic features.

Material and Methods

Two widely cultivated Spanish bunch varieties but susceptible to late leafspot disease (TMV2 and JL 24) were used as female parents and two resistant germplasm lines (RMP 12 and PI 393516) were used as male parents [5]. Single and multiple crosses viz., back, three-way and double crosses were made and the segregating material was advanced from S_1 to S_3 generation using different selection schemes as follows.

Selection scheme 1: Crosswise, the plants were advanced from S_1 to S_3 generation through Single Seed Bulk (SSB) method.

Selection scheme 2: Single plants selected for yield and/or late leafspot resistance were advanced from S_1 to S_3 generation by Single Seed Bulk method.

Selection scheme 3: Plants selected for only for late leafspot resistance were advanced from S_1 to S_3 generation as bulks to constitute mass selection.

The selection schemes employed were aimed at obtaining superior plants in productivity and/or disease resistance attributes. A total of 6915 plants obtained from 376 F_1 hybrid plants were evaluated crosswise in s_1 generation [Table-1]. Individual plants in each cross that exceeded mean +2 standard deviation with respect to pod weight and remaining green leaf area were selected for yield and resistance respectively [1].

The material constituting 150 seeds in each cross advanced through 3 different selection schemes were sown separately and single plants were assessed. Sixty plants per cross and ten plants per parent were chosen for recording the resistance and yield parameters.

Observations were recorded on yield/productivity parameters like pod yield per plant (PY), shelling percentage (SP) and hundred seed mass (HSM) and late leafspot disease resistance components viz., defoliation percentage (DF), leaf area affected (LAA) and remaining green leaf area percentage (RG).

The statistical analysis for data on each character was carried out using individual plant observations. Phenotypic coefficient of variation (PCV), broad sense heritability (H), genetic advance over mean (GAM), phenotypic correlation coefficient (r) were computed by using appropriate equations. Percent superior segregants and percent superior in different breeding schemes were computed for the parameters under consideration.

Table 1- Advancement of segregating material from S_1 to S_3 generation in groundnut crosses

Cross	F_1 Hybrid plants	No. of S_1 plants	Single plant yield (g)		Single plants selected for yield	Green Leaf area (%)		Single plants selected for green leaf area
			Mean	SD		Mean	SD	
A×C	25	373	14.6	7.8	10	46.5	7.8	1
A×D	35	370	10.2	6.8	15	41.7	7.8	4
B×C	25	338	14.1	7.6	10	50.1	7.2	3
B×D	45	740	12.7	7.5	32	41.9	6.2	21
A×(B×C)	38	844	15.7	8.7	38	50	7.6	19
A×(B×D)	15	382	13.1	7.3	5	46.8	6.8	13
B×(A×C)	25	448	13.2	7.7	20	54.5	6.6	6
B×(A×D)	24	490	18.4	8.7	18	47.6	6.6	13
A×(A×C)	22	462	14.4	7.9	19	52.3	7.5	6
A×(A×D)	45	990	10.7	5.3	32	47.4	6.9	21
B×(B×C)	26	437	14.4	7.7	17	52.5	8.4	5
B×(B×D)	12	364	18.6	8.1	20	44.4	5.3	5
(A×D)×(B×C)	39	677	15	7.7	23	44.9	10.7	12
Total	376	6915			269			129

Results and Discussion

Three selection schemes were employed for advancing different types of crosses in order to find the efficient way of handling segregating generations in groundnut. Scheme I referred as single seed bulk (SSB) in which selection was not practiced either for yield or for resistance. Scheme II involved selection for both yield and resistance and advanced through SSB, while Scheme III adopted selection for only resistance and material was advanced as bulks.

The ultimate worth of breeding methods can best be judged by the frequency of superior segregants for individual characters and combinations of characters. With this view, desirable segregants were identified as those plants with greater or lesser values than the best check, JL24, depending on the characters under consideration. The SSB (without selection) was better than other selection schemes in recovering more number of desirable segregants for yield parameters except HSM [Table-2].

Frequency of high yielding, resistant plants in SSB method was high compared to other selection schemes due to some unselected susceptible plants giving resistant progeny in subsequent generations [Table-3]. The existence of multiple recessive factors for late leafspot resistance leading to delayed segregation and expression could be the major reason for this behaviour. Unselected bulks developed with SSD method generally performed better than the sequential selections in groundnut breeding programme [2]. Considering all these, Single Seed Bulk breeding scheme without selection was better for maintaining higher variability and realising more number of recombinants. Likewise selection of single plants for yield and/or resistance and further advancement by SSD method was also a suitable approach to recover high yielding and resistant segregants. But this procedure involved extra cost and more efforts when compared to SSB method.

Based on the results a comprehensive breeding approach for developing disease resistant and productive cultivars has been proposed wherein back and three-way crosses have to be generated using adapted cultivars and resistant sources. Such crosses are to be forwarded through Single Seed Bulk scheme up to S_3 generation where they can be tested for resistance and productivity. The superior material may be subjected to preliminary yield trials, multilocational trials and finally released for cultivation. Selective inter-mating among superior segregants but otherwise deficient in one or a few characters can be carried out till sufficient desirable recombinants are obtained.

Table 2- percent superior segregants over JL 24 in different selection schemes in S_3 generation

Parameters	Selection schemes			Average of all the schemes
	I	II	III	
Yield				
PY	38.1	35.1	21.9	31.7
SP	34.2	25.9	23.6	27.9
HSM	14.4	15.3	12.5	14.1
Resistance				
LAA	76.9	49.2	77.4	67.8
DF	44.1	61.7	58.5	54.7
RG	47.4	59.5	59.6	55.5

Table 3- percent superior recombinants over JL 24 in different selection schemes in S_3 generation

Character combinations	Selection schemes			Average
	I	II	III	
1) PY-SP	14.6	12.3	6.7	11.2
2) PY-HSM	8.4	8.3	6.6	7.8
3) PY-SP-HSM	4.6	4.9	2.2	3.9
4) PY-RG	19.9	20.3	14.3	18.2
5) PY-RG-SP	7.3	6.3	4.8	6.1
6) PY-RG-HSM	4.7	4.2	4.7	4.5
7) PY-RG-SP-HSM	3.3	3.0	1.4	2.6

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