A PRELIMINARY NOTE ON THE MODE OF INHERITANCE OF REACTION TO WILT IN *CICER ARIETINUM*.

By V. Ramanatha Ayyar
and
R. Balasubramania Iyer.
(*From the Agricultural Research Institute, Coimbatore*).

Received June 17, 1936.

One of the handicaps for the successful cultivation of Bengal gram (*Cicer arietinum*) in the Coimbatore district is the wilting of a fairly large number of plants during their growth (*vide* Plate XXI). Counts of such plants made in the crops raised at the Cotton Breeding Station, Coimbatore, during 1930–35 showed that the annual loss on this account varied from 14 to 28%. These deaths were traced by Narasimhan (1928)* to a fungus of the *Fusarium* group.

Among the many strains isolated at the Cotton Breeding Station, Coimbatore, primarily for variation in yield, two, *viz.*, Nos. 19 and 468, manifested consistently marked differences in their reaction to wilt. Their behaviour during the past several years are given in Table I.

Table I.

Annual variation in the percentage of mortality.

Year	Strain No. 19	Strain No. 468
1931—32 ..	42·0	1·5
1932—33 ..	43·0	2·0
1933—34 .	43·0	0·4
1934—35 ..	48·0	6·0
1935—36 ..	36·0	7·0

* R. Narasimhan, "A preliminary note on a *Fusarium* parasite on Bengal gram (*Cicer arietinum*), *Mad. Agri. Dept. Year-book*, 1928.

Since these strains were not grown on the same site every year and since no precaution was taken to see by artificial introduction that the disease organism was present to a uniform degree in all the plots, it was considered likely that the differences observed in the mortalities were brought about by variations in the distribution of the pathogene in the soil. With a view to clear this point a small experiment was carried out in 1935. The seeds of the two strains were planted in the following three ways in small randomised plots repeated 4 times :—

(*a*) Two seeds of strain 468 only per hole in all the rows of a plot.
(*b*) Two seeds of strain 19 alone per hole in all the rows of a second plot.
(*c*) Two seeds made up of one seed of 468 and another of 19 in each hole in all the rows of a third plot.

It was presumed that by this treatment similar conditions of infection would be present for both the strains.

Records of their germination and subsequent weekly mortality were maintained. Since the two strains differed widely in their mode of branching and in the colour of the seed coat, it was easy to identify the type that succumbed to the disease in the mixed series. The results are given in Table II.

TABLE II.

Nature of treatment	Total No. of plants in all the repetitions	Percentage of germination					Percentage of mortality				
		Repetition				Average	Repetition				Average
		1	2	3	4		1	2	3	4	
(*a*) 468	1435	84.2	72.9	87.3	94.1	84.6	5.9	8.1	5.7	5.3	6.3
(*b*) 19	1509	89.9	88.2	83.3	94.6	89.0	42.0	64.7	42.5	44.6	48.5
(*c*) 468 only	726	80.2	83.5	84.9	93.9	85.6	8.2	11.3	6.1	9.3	8.7
19 only	841	90.2	96.9	93.7	94.6	93.9	53.0	54.0	56.0	51.0	53.5

It is evident from the above data that the germination was not affected and that even under similar conditions of exposure to the pathogene (*vide* treatment c), the strains showed themselves to be distinctly different in reaction to wilt. It would appear that by sowing the two strains in the same hole, the degree of reaction to the disease was a bit enhanced.

The strains were crossed with a view to determine their modes of inheritance of the differential response to wilt. Only one plant was

secured in F_1 which gave rise to 101 plants in F_2. Of these, 8 plants died of wilt before they reached the flowering phase, while another 17 withered late in the season after yielding a few seeds. The remaining 76 continued to be healthy till they were harvested.

It is hazardous to hypothesise from the proportion of 76 healthy to 25 wilted plants obtained in F_2 that the behaviour of these strains is influenced by a single pair of genes. For, all the plants either under 'healthy' or 'wilted' categories do not completely consist of such types. A healthy strain contains only a certain proportion of healthy plants. In the case of strain 468, for instance, only 93% will on the average remain alive and the remaining 7% will die of wilt in any case and hence will be classified under 'wilted' though belonging genotypically to the resistant group. In a similar way, all the survivors in strain 19 will phenotypically be classed under 'healthy' though of susceptible group. It was therefore essential that all the F_2 plants should be carried forward to the F_3 for assessing correctly the degree of infection.

As the proportion of mortality would be fictitiously high in very small populations, all plants with less than 20 seeds were not carried forward to F_3. 50 families from the healthy and 9 families from the wilted groups were raised in separate progeny rows. The parents were sown once after every five rows of the above series. Records of wilting were maintained for each family. When the season was over, the parents of F_3 progenies were rearranged according to their degree of mortality in F_3 populations in classes of 5% as shown in Table III.

It is clear from the nature of distribution, though small, that the reaction to wilt in the parents under study does not belong to the multiple factor type of inheritance. The higher number of readings under classes 0, 5, 10 and 15% is suggestive that dominance is at work; but the proportion betwen the number of readings above and below the 20% limit where the distribution of the two parents merge, indicates that the dominance is incomplete.

The progenies of 6 families consisting of 3 from the lower and 3 from the higher mortality classes were further studied in F_4. All the three from the former group proved homozygous for 'resistant' to wilt. But in the latter, two alone were homozygous for high mortality, the third being intermediate in the distribution (*vide* Table III). The higher proportion of homozygous cultures secured above, leads one to suspect that only one pair of factors control the differences in the reaction to wilt noticed in the parents. A study of all the F_4 generations which is under way, will finally decide this point.

TABLE III.

To show distribution in the parents and their progenies.

Variety	Parental value	Percentage of mortality (mid-values)																Total
		0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	
Strain 468 (Resistant parent) ..		16	23	18	5	2													64 samples
Strain 19 (susceptible parent ..						2	12	11	11	8	5	4	4	4	2			1	64 ,,
F_2 (classified from F_3 behaviour)																			
From healthy plants ..		9	10	5	5	5	4	4	3	4			1						50 families
,, 'wilted' ,, ..				1									1	1		2	2	2	9 ,,
F_4 ..	0%	15	9	2															26 sibs.
	3%	20	22	16															58 ,,
	9%	11	13	2															26 ,,
	56%		1	3	2	2	3	2											13 ,,
	77%					2	1	3	3	3	3	1	6	3					25 ,,
	77%					1		1		1		2		1					6 ,,

TABLE IV.

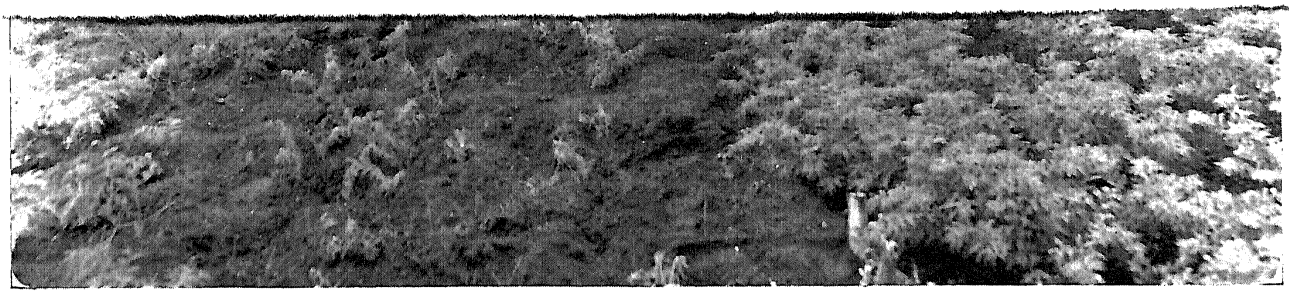
To show relationship between reaction to wilt, branching habit and seed-coat colour.

Generation	Character	Percentage mortality	No. of families studied	Total number of plants studied	Actual number of plants				Expected ratio	Value of P
					Branched		Not branched			
					Dark Brown C. S. 12	Light Brown C. S. 10	Dark Brown C. S. 12	Light Brown C. S. 10		
F_2	Wilted		1	17	9	3	4	1	9 : 3 : 3 : 1	> 0.9
	Living		1	70	42	13	12	3	do.	> 0.8
F_3	Susceptible	29, 33	2	13	All					
		22	1	31		All				
		69	1	14			All			
		24	1	75				All		
		22, 31 82	3	86		61		25	3 : 1	> 0.3
		27, 72 77, 79	4	136			97	39	3 : 1	> 0.3
		29, 56	2	43	28		15		3 : 1	> 0.3
		23, 33 33, 37 40, 58 78 & 79	8	264	136	54	53	21	9 : 3 : 3 : 1	$> 3{\cdot}0$
	Resistant	4, 6, 11 14	4	54		All				
		0, 3, 4, 4	4	199		148		51	3 : 1	> 0.9
		10	1	20	15	5			3 : 1	1.0
		9, 19	2	76	53		23		3 : 1	> 0.2
		2, 7, 9	3	123	67	32	19	5	9 : 3 : 3 : 1	> 0.1

Errata.

Vol. III, No. 6.

Page 442, under the last column, value of P, *for* "> 3·0" *read* "> 0·3".



Susceptible Resistant.

Photograph of a field where susceptible and resistant types were grown side by side.