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ANALYSIS OF GROWTH PATTER N RUST RESISTANT GENOTYPES OF GRO

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ABSTRACT

The physiological phenomena of yield barriers in rust resistant groundnut genotypes were studied using growth analysis as a tool. Ten genotypes including four susceptible, three each from partial resistant and resistant categories were subjected for the study. Higher CGR, LAR and LAI during the pod filling and maturity stages in resistant and partially resistant genotypes indicated more partitioning of dry matter to leaf tissues rather than to pods, resulting in poor development of pods and kernels. The evolution of partially resistant varieties in preference to completely resistant ones for cultivation in endemic areas will be more useful.

KEY WORDS : Susceptible, Partially Resistant, Resistant, Crop Growth Rate, Pod Growth Rate.

Resistance to foliar diseases has been reported to be associated with low yield potential in groundnut. Further, there seems to be a "resistance/yield barriers" genetic mechanism (Williams *et al.*, 1984). Therefore, an investigation of the physiology of this phenomenon will be useful to formulate breeding programmes for disease resistance.

MATERIALS AND METHODS

The study was conducted at the Agricultural Research Station, Aliyarnagar during *rabi* - summer 1990-91 season on a sandy loam soil involving ten genotypes drawn from susceptible (Co.2, JL 24, VRI 1 and VRI 2), partially resistant (ALG 33, DORG 18-10 and ICG (FDRS) 43 and resistant (NCAC 17090, NCAC 17135 and ICG (FDRS)10 groups. The experiment was laid out in randomized block design with three replications. A plot size of 5 x 3 m with a spacing of 30 x 10 cm and the recommended manurial schedule of 15:30:45 kg NPK/ha were adopted. Necessary prophylatic measures were taken up periodically. In order to understand the physiology of growth stages, the crop was subjected to destructive and non destructive analysis. Sampling was done on 30,50,70,90 and 110 days after sowing for destructive analysis.

The growth stages were divided into vegetative (0-30 days), flowering and pegging (30-50 days), pod formation (50-70 days), pod filling (70-90 days) and pod maturity (90-110 days). The growth analysis was made by recording the mean total accumulated plant weight (biological yield), mean leaf area and mean dry weight of different plant organs including weight of economically important part, the pod, at the beginning as well as at the end of the plant growth. These parameters were used to compute the crop growth rate (CGR) relative growth rate (RGR), leaf area ratio (LAR) leaf area index (LAI), pod growth rate (PGR) and kernel growth rate (KGR) following Watson (1952) and Radford (1967).

RESULTS AND DISCUSSIONS

The dry matter production in general, had a lag phase in the vegetative stage (Table 1). It gradually gained momentum in the early second phase, marked by production of flowers. Accumulation of dry matter had a linear trend in the late second and third phases when transformation of flowers into pegs and pods take place. Thereafter the dry matter production declined. At maturity 32.6, 29.9 and 28.0 g/plant of DMP were recorded by partially resistant, resistant and susceptible genotypes. The crop growth rate showed an increasing trend upto pod formation and declined gradually. A maximum CGR of 26.6 g/m^2/day was recorded by susceptible genotypes whereas, resistant and partially resistant genotypes registered lower values of 24.3 and 23.3 g/m^2/day. The trend of DMP and CGR was common to all the three groups of varieties. However, the accumulation of dry matter is lower in susceptible group than that in the resistant categories during the pod filling and pod maturity phases. There was only minimum vegetative growth beyond pod formation stage in the susceptible genotypes. Obviously, poor growth rate

Table 1. Dry weight and, different growth parameters at various growth stages in groundnut genotypes.

Genotype	DMP (g/plant)					CGR (g/m²/day)					RGR (g/g/day)				
	S_1	S_2	S_3	S_4	S_5	S_1	S_2	S_3	S_4	S_5	S_1	S_2	S_3	S_4	S_5
Susceptible															
Co 2	2.6	6.1	21.0	24.2	25.7	2.8	5.8	24.9	5.3	2.5	0.195	0.043	0.062	0.007	0.003
JL 24	3.3	6.8	20.5	21.7	28.8	3.6	5.8	22.9	2.0	11.8	0.196	0.037	0.056	0.003	0.014
VRI 1	2.1	6.5	23.0	25.2	26.2	2.3	7.4	27.5	3.6	1.8	0.249	0.058	0.063	0.045	0.002
VRI 2	2.5	10.7	29.7	30.4	31.5	2.7	13.7	31.8	1.1	1.9	0.157	0.073	0.051	0.001	0.002
Mean	2.6	7.5	23.6	25.3	28.1	2.9	8.2	26.8	3.0	4.5	0.199	0.053	0.058	0.014	0.005
Partial resistant															
ALG 33	2.4	8.2	21.5	26.0	31.2	2.6	9.6	22.3	7.5	8.6	0.180	0.062	0.049	0.010	0.009
DORG 18-10	2.0	9.8	24.3	29.2	34.2	2.2	13.0	24.2	8.1	8.3	0.154	0.079	0.045	0.009	0.008
ICG (FDRS) 43	1.9	8.4	23.3	29.2	32.2	2.1	10.9	24.8	9.8	5.3	0.142	0.076	0.053	0.001	0.005
Mean	2.1	8.8	23.0	28.1	32.6	2.3	11.2	23.8	8.5	7.4	0.159	0.072	0.049	0.007	0.007
Resistant															
ICG (FDRS) 10	1.9	9.0	26.2	29.9	34.7	2.2	11.8	28.6	6.2	8.1	0.150	0.076	0.053	0.007	0.008
NCAC 17135	2.0	7.2	22.0	24.4	26.0	2.2	8.6	24.8	3.9	2.8	0.154	0.064	0.056	0.005	0.003
NCAC 17090	2.4	6.8	18.5	27.2	28.9	2.7	7.3	19.5	14.5	2.8	0.184	0.052	0.050	0.019	0.003
Mean	2.1	7.7	22.2	27.2	29.9	2.4	9.2	24.3	8.2	4.6	0.163	0.064	0.053	0.010	0.005
SE(m)	0.21	0.82	1.52	3.42	3.38	0.31	0.62	1.47	2.54	3.56	0.009	0.003	0.0013	0.0016	0.002
CD (0.05)	0.62	2.44	4.52	NS	NS	0.92	1.87	4.37	7.56	NS	0.03	0.008	0.004	0.005	0.006

S_1 = 0-30 DAS S_2 = 30-50 DAS S_3 = 50-70 DAS S_4 = 70-90 DAS S_5 = 90-110 DAS

Genotype	LAR (cm²/g)					LAI					PGR (g/plant/day)			KGR (g/plant/day)		
	S_1	S_2	S_3	S_4	S_5	S_1	S_2	S_3	S_4	S_5	S_3	S_4	S_5	S_3	S_4	S_5
Susceptible																
Co 2	196.2	314.8	143.7	56.1	35.2	1.6	6.3	11.9	3.9	2.9	0.118	0.145	0.190	0.053	0.135	0.080
JL 24	266.3	294.2	106.1	77.9	69.7	2.9	6.6	9.8	3.7	3.7	0.158	0.315	0.018	0.068	0.049	0.034
VRI 1	323.0	328.9	129.4	47.8	40.1	2.2	7.1	9.6	4.0	3.5	0.193	0.023	0.230	0.098	0.174	0.009
VRI 2	388.7	299.6	83.7	53.9	30.6	3.1	10.6	8.3	5.5	1.6	0.235	0.300	0.042	0.125	0.205	0.113
Mean	293.6	309.4	115.8	58.9	43.9	2.5	7.7	9.9	4.3	2.9	0.176	0.196	0.120	0.086	0.141	0.059
Partial resistant																
ALG 33	270.8	281.3	111.1	48.1	33.3	2.1	7.2	9.6	3.4	3.5	0.200	0.010	0.220	0.093	0.180	0.153
DORG 18-10	289.3	262.3	86.3	33.2	29.3	1.9	8.6	9.9	2.7	2.7	0.308	0.090	0.185	0.145	0.200	0.068
ICG (FDRS) 43	299.4	247.9	114.3	36.8	40.6	1.8	6.8	8.7	3.6	3.1	0.110	0.020	0.200	0.040	0.149	0.024
Mean	286.5	263.8	103.9	39.4	34.4	1.9	7.5	9.4	3.2	3.1	0.206	0.040	0.220	0.093	0.176	0.082
Resistant																
ICG (FDRS) 10	281.0	259.9	111.8	55.8	51.4	1.8	7.8	8.6	5.1	6.1	0.190	0.103	0.135	0.042	0.143	0.063
NCAC 17135	255.5	257.5	125.8	49.6	43.7	1.7	6.1	8.3	3.7	3.1	0.160	0.040	0.038	0.044	0.097	0.008
NCAC 17090	279.6	200.8	127.4	78.2	74.2	2.2	4.6	7.0	6.7	7.3	0.083	0.003	0.275	0.012	0.111	0.025
Mean	272.0	239.4	121.7	61.2	56.6	1.9	6.2	7.9	5.2	5.5	0.144	0.049	0.483	0.033	0.117	0.032
SE(m)	10.8	8.15	5.65	7.5	17.32	0.17	0.24	0.29	0.35	0.5	0.019	0.027	0.093	0.0078	0.011	0.014
CD (0.05)	32.0	24.2	16.82	22.2	NS	0.52	0.72	0.86	1.06	1.49	0.058	0.081	0.277	0.023	0.032	0.042

during the later part coupled with effective translocation of accumulates to the developing pods lead to better pod filling in the susceptible varieties. The above fact is also supported from the phenomenon that there is a barrier between yield and resistance in this crop (Williams *et al.*, 1984). A linear increase in drymatter production upto peg formation as observed in the present study was also reported by Seshadri (1962) and Suraj Bhan (1973).

A Progressive reduction in relative growth rate (RGR) was observed in all the groups of varieties. During vegetative stage, higher RGR of 0.199 g/g/day was recorded by susceptible genotypes, whereas in the resistant and partially resistant

Table 2. Pod yield, quality attributes and reaction to rust disease in three categories of groundnut genotypes.

Genotypes	Rust (1-9 scale)	Pod yield (g/m^2)	Shelling (%)	kernel yield (g/m^2)
Co 2	7	184	74.6	136
JL 24	8	182	73.5	134
VRI 2	8	193	74.0	143
VRI_1	8	177	74.5	132
ALG 33	4	168	73.6	123
DORG 18-10	4	168	71.5	120
ICG (FDRS) 43	4	169	72.0	122
ICG (FDRS) 10	2	176	65.5	115
NCAC 171135	2	152	64.0	97
NCAC 17090	2	176	64.5	114
SE		2.2	0.60	1.17
CD		6.5	1.78	3.46

genotypes the values were 0.163 and 0.159 g/g/day, respectively. Janmatti (1979) also observed a progressive decrease in RGR in all the varieties studied.

The leaf area is relation to total dry weight of plant (LAR) decreases markedly after the second phase, characterised by flowering. A similar trend was reported by Shanthakumari *et al.*, (1988). LAR was higher in susceptible genotypes upto flowering 309.37 cm^2/g). But resistant genotypes registered higher values of LAR during pod formation, pod filling and maturity phases. The leaf production and vegetative growth continued in the resistant and partially resistant groups, even in the Later phases of crop growth, resulting in higher LAR. This was also reflected in the leaf area index which attained maximum in the pod formation stage in these two groups but decreased later. LAI was higher is susceptible genotypes upto pod formation stage, whereas the resistant genotypes recorded higher values during pod filling and pod maturity phase. During pod formation stage, the susceptible genotypes recorded 9.93 as against 9.37 and 7.96 respectively, by partially resistant and resistant genotypes.

The pod growth rate increased slightly from formation to filling but decrease subsequently upto maturity in the susceptible group of genotypes. In constrast, the PGR showed a decreasing trend from pod formation to filling in the resistant genotypes but a steep increase was registered in the pod maturity phase (0.05 - 0.46 g/plant/day). Interestingly, the behaviour in partially resistant group was intermediate. The absence of desired level of pod growth in the pod formation and filling phases in the resistant and partially resistant varieties could not be compensated by exceptionally higher growth rate of pod in the maturity phase, thereby resulting in lower pod and kernel yields. The trend of kernel growth rate was more or less similar to the corresponding PGR of all the three groups but the rate was always higher in the susceptible genotypes. Also the higher pod growth rate in the maturity phase was not accompanied by proportionate growth in the kernel size of the resistant and partially resistant genotypes, suggesting that accumulation mostly occured in the alternative part of the sink, the pericarp. Thick shell and poor recovery of kernels in this group substantiate this phenomenon.

The yield in groundnut is a function of physiological processes occuring at different growth stages of the crop, leading to variation in the production potentilas among the genotypes. Variation in yield potential of groundnut cultivars due to differences in partitioning of assimilates was observed by Duncan *et al.*, (1978). In the present study, the low yield levels in resistant genotypess (Table 2), When compared to cultivated varieties, could be attributable to their indeterminate growth as evident from continued drymatter production even at pod maturity, poor translocation of source to the sink, initial set back in PGR, lwo KGR and wide differences between PGR and KGR. Thus, the physiological implications suggest that partial resistance is preferable as compared to complete resistance to foliar diseases, wherever such varieties are to be essentially developed. The genetic advantages of partial resistance in groundnut have also been reported by Parlevlite (1984).

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VARIABILITY, HERITABILITY AND GENETIC ADVANCE IN FODDER PEARL MILLET

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ABSTRACT

Genotypic coefficient of variation, heritability and genetic advance were assessed in 28 genotypes of fodder pearl millet (*Pennisetum glaucum*.) The difference between the genotypes were highly significant for all the 18 characters studied. Among the characters, stem weight, green fodder yield per plant, leaf weight, number of tillers per plant and number of leaves per plant showed high genotypic coefficients of variation. Stem weight, green fodder yield per plant, leaf weight, leaf stem ratio, plant height on the 30th day, plant height at harvest, crude protein content and dry matter content had high heritability combined with high genetic advance. These traits are the most suitable for improvement through selection.

KEY WORDS : Fodder pearl millet, Variability, Heritability, Genetic advance.

Pearlmillet (*Pennisetum glaucum*) an annual diploid (2n=14) assumes specific importance as a major grain cum fodder crop of the arid and semi-arid tracts of India and Africa. It can be fed to cattle without harm at any stage of growth (Krishnaswamy, 1962). Though it has dual utility value, breeding in the past was mainly concerned with increasing its grain yield but fodder aspect was considered as secondary. Studies on variability in *Pennisetum glaucum* have so far been carried out with grain types and such a study involving fodder types will be more purposeful and effective. Keeping this in view, 28 fodder pearlmillet genotypes were subjected to detailed investigation on variability, heritability and genetic advance.

MATERIALS AND METHODS

A set of 28 genotypes of fodder pearlmillet obtained from the breeder, All India Co-ordinated Research Project on Forage crops, Coimbatore, were grown at the school of Genetics, Tamil Nadu Agricultural University, Coimbatore during *rabi* 1991 in randomised block design with two replications. Selfed seeds of each genotype were sown with the spacing of 30 cm between rows and 15 cm between plants. Data were recorded at the time of 50 per cent flowering from five randomly selected competitive plants in each genotype in each replication for green fodder yield and its component characters. Representative plant samples from each replication were taken after the harvest for estimating dry matter, ash and crude fat contents (AOAC, 1970), crude protein content (Humphries, 1956), crude fibre content (Goering and Vansoest, 1970) and oxallic acid content (Talapatra *et al.*, 1948). Standard statistical procedures were used for the analysis of variance, genotypic and phenotypic coefficients of variation (Burton, 1952), heritability (Hanson *et al.*, 1956) and genetic advance (Lush, 1949; Johnson *et al.*, 1955)