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International Crops Research Institute for the Semi-Arid Tropics Center, Patancheru, Andhra Pradesh, India

Effects of Temperature and Photoperiod on Vegetative and Reproductive Growth of Groundnut (*Arachis hypogaea* L.)*

S. N. Nigam, R. C. Nageswara Rao and J. C. Wynne

Authors' addresses: Dr S. N. Nigam and Dr R. C. Nageswara Rao (corresponding author), International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) Center, Patancheru, Andhra Pradesh 502 324, India; Dr J. C. Wynne, North Carolina State University, Raleigh, NC 27607, USA

With 2 figures and 4 tables

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Abstract

Effects of temperature × photoperiod interaction on vegetative and reproductive growth were examined in three selected groundnut genotypes by growing them in controlled-environment growth chambers with three temperature regimes (22/18, 26/22, and 30/26°C, day/night) under long (12 h, long day), and short (9 h, short day) photoperiods.

The effect of photoperiod on the total dry-matter production (TDM) was significant with the genotypes producing 32–72 % greater dry matter under LD than SD. Temperature × genotype interaction effects were significant, with the dry-matter production being greatest at 26/22°C and least at 30/26°C and 22/18°C in two of the three genotypes.

Leaf area (LA) was greater under LD than SD at all temperature regimes. LA accounted for 76 % of the variation in shoot + root dry weight ($R^2 = 0.76$, $P < 0.01$). A lack of relationship between LA and pod weight or pod numbers suggested that the pod development is controlled by factors other than carbon assimilation.

The temperature × photoperiod interaction was significant for root growth, with the root weight being maximal and photoperiod effects being minimal at 22/18°C, while at 26/22°C, root weight declined and photoperiod effects became prominent. Low temperature (22/18°C) affected the reproductive development by reducing the proportion of reproductive nodes in total (vegetative + reproductive) nodes. The conversion of pegs into pods, as indicated by pod to peg ratio (PPR), was lower in LD than in SD conditions. Results suggested that the PPR could be used as an indicator of genotypic sensitivity to photoperiod in groundnut.

Key words: Groundnut — *Arachis hypogaea* L. — photoperiod — temperature — growth — partitioning

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Introduction

An understanding of the action of photoperiod and temperature on processes determining the yield is basic for the crop improvement and modelling efforts. The cultivated groundnut (*Arachis hypogaea* L.) exhibits a qualitative response to photoperiod with long days stimulating vegetative growth and reducing pod yields (Wynne et al. 1973, Emery et al. 1981). Earlier studies, conducted in controlled environment growth chambers, have indicated that the extended photoperiod reduced reproductive growth by affecting the partitioning of dry matter to pods (Wynne and Emery 1974, Emery et al. 1981, Nigam et al. 1994). Genotypic variation for photoperiod responses has been observed in growth chamber (Bagnall and King 1991, Nigam et al. 1994) and field studies (Witzenberger et al. 1988, Flohr et al. 1990). However, temperature can also influence the growth and development of groundnut significantly (Leong and Ong 1983). Nigam et al. (1994) observed significant genotypic variability for photoperiod × temperature interaction in partitioning of dry matter to pods, which plays an important role in the adaptation of genotypes to new environments. However, the utility of photoperiod sensitivity has been very limited in crop improvement, mainly because of limited understanding of photoperiod × temperature interactions on reproductive processes and lack of simple and reliable screening tools to identify the sensitive genotypes. The present paper examines the effects of photoperiod and temperature and their interaction on dry matter production, partitioning to various organs, and reproductive development in three selected groundnut genotypes grown in controlled environment growth chambers.

Materials and Methods

The details of genotypes and experimental methodology are described in Nigam et al. (1994). Three groundnut genotypes, TMV 2, NC Ac 17090, and VA 81B, were grown in six walk-in growth chambers at three temperature regimes (22/18, 26/22, and 30/26°C day/night) under long day (LD), and short day (SD) photoperiods, in the phytotron unit of the Southern Plant Environment Laboratory, North Carolina State University, Raleigh, North Carolina, USA.

Under LD conditions, plants were exposed to 9 h of artificial illuminance (598 μmol m^{-2} s^{-1}) followed by a dark period which was interrupted in the middle of the night, for a period of 3 h (2300–0200 h), by a low intensity light ($\geq$44 μmol m^{-2} s^{-1}). Under SD conditions, plants were subjected to 9 h of artificial illuminance (598 μmol m^{-2} s^{-1}) followed by an uninterrupted dark period of 15 h. The genotypes reached maturity at different times depending on the temperature regime in which they were grown. Thermal time to maturity was assessed (assuming a base temperature of 10°C) from a few extra pots of each genotype, kept at 26/22°C, and the genotypes from the three temperature regimes were harvested as and when they reached required thermal time for maturity. Accordingly, TMV 2, NC Ac 17090, and VA 81B were harvested at 86, 90, and 101 days after sowing (DAS) at 30/26°C, on 110, 115, and 130 DAS at 26/22°C, and on 154, 161, and 182 DAS at 22/18°C, respectively. The plants were harvested along with roots and washed to remove soil. The number of vegetative and reproductive nodes and pegs were counted. The leaves, pods and roots were then separated from stem. Leaf area was measured on a leaf sub-sample using a leaf area meter (LICOR-3100*) and the dry weight of the leaf sub-sample was determined.

Dry weight of the remaining leaves, stem (with pegs) and roots was determined after oven-drying the samples at 70°C for 24 h. The leaf area per plant was computed using the specific leaf area of the leaf sub-sample and dry weight of the remaining leaves.

The pods were sun-dried for 2 weeks and separated into immature and mature groups. Both groups of pods were oven-dried at 33°C for 48 h to ensure uniformity in drying before weighing. Mature and immature pods were shelled and the number of seeds was counted and the dry weight of shell and seed was recorded. The total dry matter (dry weight of shoot + root + pods) was estimated after adjusting for high energy content in pods (Duncan et al. 1978). The experiment was run in two cycles which were used as replicates.

Growth and development of organs under various treatments was examined by estimating the following parameters:

$$\text{Root to shoot ratio (RSR)} = \frac{\text{Root dry weight}}{\text{Shoot (stem + leaf + pods) dry weight}}$$

$$\text{Reproductive node ratio (RNR)} = \frac{\text{Number of reproductive nodes}}{\text{Number of vegetative + reproductive nodes}}$$

$$\text{Peg to reproductive node ratio (PRNR)} = \frac{\text{Number of pegs}}{\text{Number of reproductive nodes}}$$

$$\text{Pod to peg ratio (PPR)} = \frac{\text{Number of pods (immature + mature)}}{\text{Total number of pegs}}$$

The above ratios were tested for their normal distribution (Shapiro and Wilk, 1965) before statistical analysis. The analysis showed that the ratios were normally distributed. The data were analysed using PROC GLM procedure of SAS (Anon. 1985).

Results

Leaf growth

Leaf dry matter was significantly ($P < 0.01$) greater in LD (by 114% in TMV 2, 61% in NC Ac 17090, and 25% in VA 81B) than in SD (data not presented). Consequently, plants under LD had significantly greater ($P < 0.01$) leaf area (0.57 m^2 pl^{-1}) than under SD (0.28 m^2 pl^{-1}) (Tables 1 and 2). Genotypic variation was significant ($P < 0.01$), with NC Ac 17090 having the largest (0.59 m^2 pl^{-1}) and VA 81B having the smallest (0.25 m^2 pl^{-1}) mean leaf area per plant (pooled over photoperiod and temperature). The temperature effect on leaf area development, however, was not significant within the range of temperature regimes examined in the present study (Table 1).

Root growth

Root weight was, in general, higher ($P < 0.01$) in LD than in SD and the root growth increased as temperature declined under both LD and SD (Table 2). Temperature × photoperiod interaction was significant ($P < 0.05$) for root weight (Table 1) with the difference due to photoperiod treatments being the greatest at 26/22°C, and the smallest at 22/18°C in all three genotypes (Table 2). Genotypes differed significantly ($P < 0.01$) in root weight, with NC Ac 17090 having the greatest root weight, followed by TMV 2 and VA 81B.

* Mention of commercial products or companies does not imply endorsement or recommendation by ICRISAT over others of similar nature.

Table 1: Mean squares for the leaf area (m^2 pl^{-1}) and dry weight of various plant components (g pl^{-1}) of three genotypes grown under two photoperiods and three temperature regimes

Source of variation	DF	Leaf area	Root weight	Root to shoot ratio	Shell weight	Seed weight	TDM
Run (R)	1	114.9	10.8	0.0000	0.0	1.2	1284.2
Temperature (T)	2	105.9	297.1**	0.0285**	50.8**	480.9**	3140.8*
Photoperiod (P)	1	7252.8**	78.3**	0.0004	12.0*	0.4	14118.2**
$T \times P$	2	475.7*	36.1*	0.0040**	6.3	57.6	1554.6
$R \times T \times P$	5	45.7	4.4	0.0001	1.6	37.9*	467.8
Genotypes (G)	2	3375.8**	69.6**	0.0065**	92.3**	834.5**	1240.8*
$T \times G$	4	277.2**	12.8	0.0009	13.9**	76.7**	408.9*
$P \times G$	2	1124.7**	9.3	0.0003	6.4**	99.3**	320.4*
$T \times P \times G$	4	64.7*	6.7	0.0003	2.3	30.9*	212.8
Error	12	15.0	4.1	0.0008	0.8	8.3	106.3

*, ** Mean squares significant at $P \leq 0.05$ and $P \leq 0.01$, respectively.

Table 2: Effect of temperature (T) and photoperiod (P) on leaf area (m^2 pl^{-1}) and dry weights of various plant components (g pl^{-1}) in three groundnut genotypes (G) grown under two photoperiods (LD and SD) and three temperature regimes

Genotype	Day/night (°C)	Leaf area		Root weight		Root to shoot ratio		Shell weight		Seed weight		TDM	
		LD	SD	LD	SD	LD	SD	LD	SD	LD	SD	LD	SD
TMV 2	22/18	0.47	0.31	11.9	12.7	0.14	0.20	2.0	2.5	7.5	8.0	100.0	81.7
	26/22	0.66	0.22	10.2	3.2	0.09	0.07	7.2	3.7	18.8	18.1	132.9	59.9
	30/26	0.71	0.26	6.9	2.4	0.07	0.06	3.9	2.8	8.8	13.8	106.6	56.3
	Mean	0.61	0.26	6.0	6.1	0.10	0.11	4.4	3.0	11.7	13.5	113.2	66.0
NC Ac 17090	22/18	0.82	0.59	17.9	17.9	0.15	0.19	0.2	0.1	0.5	0.3	136.7	118.1
	26/22	0.83	0.27	15.1	4.3	0.12	0.07	7.7	7.5	13.6	22.9	155.1	85.8
	30/26	0.77	0.25	5.2	3.1	0.05	0.06	2.7	4.0	3.6	9.9	103.3	59.9
	Mean	0.81	0.37	12.7	8.4	0.11	0.11	3.5	3.9	5.9	11.0	131.7	87.9
VA 81B	22/18	0.28	0.25	10.6	10.3	0.08	0.13	10.8	7.4	30.2	21.2	131.4	105.1
	26/22	0.24	0.15	5.4	3.1	0.05	0.06	12.1	7.7	37.5	23.9	129.7	77.1
	30/26	0.35	0.27	2.9	2.6	0.04	0.04	6.4	6.7	14.9	19.3	84.8	80.2
	Mean	0.29	0.22	6.3	5.3	0.06	0.08	9.8	7.3	27.5	21.5	115.3	87.5
Overall mean		0.57	0.28	8.3	4.6	0.09	0.10	5.9	4.7	15.0	15.3	120.1	80.5
SEDs to compare over all mean of:													
a) G over T and P (Df = 12)		1.582		0.825		0.012		0.357		1.175		4.209	
b) P over G and T (Df = 5)		2.204		0.696		0.003		0.423		2.054		7.209	
c) T over G and P (Df = 5)		2.699		0.726		0.004		0.518		2.516		8.830	
d) T effects at a given level of P and G		4.957		2.044		0.024		1.024		4.264		15.061	
e) P effects at a given level of T and G		4.957		2.044		0.024		1.024		4.264		15.061	
CV (%)		9.1		25.1		31.3		16.6		19.0		10.3	

Root to shoot ratio (RSR)

RSR was greatest at 22/18°C and declined as the temperature increased, suggesting that the low temperature regime was favourable for root growth (Table 2.) However, temperature × photoperiod interaction on RSR was significant ($P < 0.01$) with photoperiod effect becoming apparent particularly under SD at 22/18°C. NC Ac 17090, followed by TMV 2, had significantly greater RSR compared with VA 81B.

Shell and seed growth

Shell weight, under both LD and SD, was greater ($P < 0.01$) at 26/22°C than at the two extreme temperatures. Genotypes varied significantly ($P < 0.01$) for shell weight, with VA 81B having the greatest shell weight. Interactions of genotypes with photoperiod and with temperature were significant ($P < 0.01$), with photoperiod effects being greatest at 26/22°C for TMV 2 and VA 81B, but not for NC Ac 17090 (Tables 1 and 2).

Although photoperiod effect on seed weight was not significant, the effect of temperature was significant ($P < 0.01$) such that the seed weight was greatest at 26/22°C and declined at both the extreme temperatures.

Temperature × genotype and photoperiod × genotype interactions had a significant ($P < 0.01$) effect on seed weight. For example, VA 81B was able to produce greater seed weight at the cool temperature regime compared to the other two genotypes. The temperature × photoperiod × genotype interaction was significant ($P < 0.05$) with the effect of photoperiod on seed weight being greatest at 30/26°C for TMV 2 and NC Ac 17090, but only marginally for VA 81B.

Total dry matter

Photoperiod ($P < 0.01$) and temperature ($P < 0.05$) had significant influence on total dry matter (TDM) production (Tables 1 and 2). Under LD, the mean TDM (pooled over genotypes and temperatures) was 120 g pl^{-1} compared to 81 g pl^{-1} under SD, representing an increase of 51% in LD over SD. Photoperiod × genotype interaction was significant ($P < 0.05$) with TMV 2 and NC Ac 17090, producing respectively, 71% and 50% greater TDM under LD than SD (compared with 32% with VA 81B).

Mean TDM (pooled over genotypes and photoperiod) was greatest at 22/18°C (112 g pl^{-1}) followed by 26/22°C (107 g pl^{-1}) and 30/26°C (82 g pl^{-1}) regimes. The temperature × genotype interaction effect on TDM was significant ($P < 0.05$). For example, NC Ac 17090 and TMV 2 produced maximal TDM at 26/22°C, which declined at both lower and higher temperatures; VA 81B maintained high TDM at 22/18°C and 26/22°C.

Leaf area accounted for 44% of the variation in TDM (Fig. 1a) and 76% variation in shoot and root dry matter across treatments (Fig. 1b).

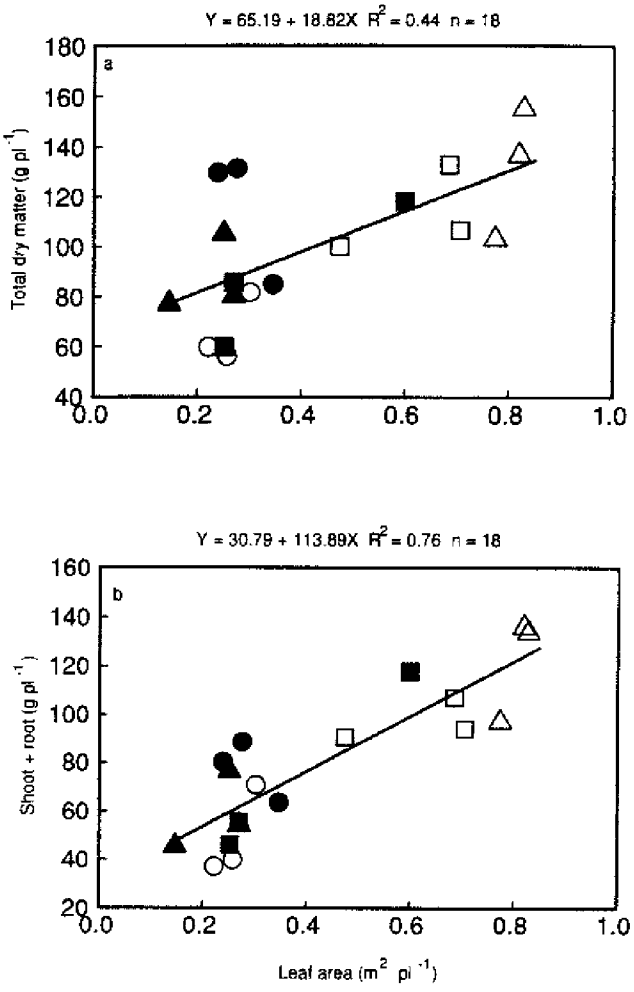

Fig. 1: Relationship between leaf area and total dry-matter (a) and shoot + root dry-matter (b) in TMV 2 (□), NC Ac 17090 (○) and VA 81B (△) genotypes grown under LD (open symbols) and SD (filled symbols) photoperiods and three temperature regimes

Reproductive efficiency

The effect of photoperiod and temperature on the conversion efficiencies of reproductive structures was studied to identify the stage at which the photoperiod might start influencing the reproductive development.

Table 3: Analysis of variance for the effects of photoperiod and temperature on reproductive node ratio (RNR), peg to reproductive node ratio (PRNR), pod to peg ratio (PPR) in three groundnut genotypes grown under two photoperiod and three temperature regimes

Source of variation	DF	RNR	PRNR	PPR
Run (R)	1	0.0016	0.0099	0.1121**
Temperature (T)	2	0.0660*	0.2653*	0.0428**
Photoperiod (P)	1	0.0042	0.0898	0.1739**
$T \times P$	2	0.0018	0.0491	0.4096**
$R \times T \times P$	5	0.0031	0.0293	0.0031
Genotype (G)	2	0.0011	0.4322**	0.0366**
$T \times G$	4	0.0056	0.0181	0.0620*
$P \times G$	2	0.0005	0.2718**	0.0187
$T \times P \times G$	4	0.0037	0.0801	0.0092
Overall Error	12	0.0019	0.0037	0.0144
CV (%)		20.3	11.3	31.6

*, ** Mean squares significant at $P \leqslant 0.05$ and $P \leqslant 0.01$, respectively.

The reproductive node ratio (RNR) was significantly influenced ($P < 0.05$) only by temperature (Table 3). The RNR was greatest (0.28) at 26/22°C and declined to 0.14 at 22/18°C (Table 4).

The peg to reproductive node ratio (PRNR) was significantly influenced by temperature ($P < 0.05$) and genotypes ($P < 0.01$) but not by photoperiod (Table 3). The PRNR was highest at 26/22°C (1.80), with a marginal reduction at 30/26°C (1.56) and 22/18°C (1.52) (Table 4). Genotypic variation for PRNR was significant ($P < 0.01$), with NC Ac 17090 having the highest PRNR (1.84) compared with 1.52 in TMV 2 and 1.50 in VA 81B (Table 4).

The mean pod to peg ratio (PPR) (pooled over genotypes and temperatures) under SD was significantly greater ($P < 0.01$) than LD. Temperature had a significant ($P < 0.01$) effect with mean PPR (pooled over genotypes and photoperiods) being greatest (0.45) at 26/22°C and declining to 0.34 at both low (22/18°C) and high (30/26°C) temperatures. Genotypes also varied significantly ($P < 0.01$) in PPR, with TMV 2 having the greatest PPR (0.48) and NC Ac 17090 having the smallest (0.20). Temperature × photoperiod interaction was significant ($P < 0.01$) (Table 3), with PPR generally declining as the temperature increased under LD conditions, while under SD conditions, no such trend was discernible. The temperature × genotype interaction was also significant ($P < 0.05$) (Table 3). The temperature regime at which the PPR was the highest varied with genotypes. For example, the PPR was highest in VA 81B and lowest in NC Ac 17090 for the lowest temperature regime. TMV 2 and VA 81B maintained relatively higher PPR across three temperature regimes.

Pod number per plant was significantly influenced ($P < 0.01$) by temperature and genotypes. The mean pod number (pooled over genotypes and photoperiod) was greatest (31 pods pl^{-1}) at 26/22°C and declined to 17 ± 2 pods pl^{-1} at both high and low temperatures. Genotypic variation in sensitivity to temperature was significant ($P < 0.01$), with NC Ac 17090 having no pods in contrast to 28 pods pl^{-1} in VA 81B at 22/18°C. The pod weight was least (28 g pl^{-1}) at 22/18°C and increased to 35 g pl^{-1} at 30/22°C, representing a significant effect ($P < 0.01$) of temperature (data not presented). However, the effect of photoperiod on pod weight was not significant, although photoperiod × genotype interaction was significant. The significant variations observed for pod weight and pod numbers were independent of leaf area (Fig. 2).

Discussion

In the present study, TDM was significantly greater under LD than SD conditions (Table 1). Stimulation of dry-matter production in LD could be attributed to a number of reasons, i.e. variation in the amount of intercepted radiation and carbon assimilation rate at canopy level. Greater assimilation in LD as a result of additional day length of 3 h can be excluded as a contributory factor to the dry-matter production, since the intensity of light provided to create LD conditions (44 μmol m^{-2} s^{-1}), was too low to have resulted in any photosynthetic activity

Table 4: Reproductive node ratio (RNR), peg to reproductive node ratio (PRNR), pod to peg ratio (PPR) of three groundnut genotypes grown under two photoperiods (LD and SD) and three temperature regimes

Genotype	Day/Night (°C)	RNR		PRNR		PPR	
		LD	SD	LD	SD	LD	SD
TMV 2	22/18	0.11	0.16	1.39	1.37	0.49	0.49
	26/22	0.33	0.23	1.63	1.94	0.42	0.66
	30/26	0.22	0.20	1.27	1.56	0.29	0.55
	Mean	0.22	0.20	1.43	1.62	0.40	0.57
NC Ac 17090	22/18	0.08	0.09	1.84	1.74	0.02	0.01
	26/22	0.27	0.27	2.08	1.84	0.21	0.53
	30/26	0.31	0.22	2.22	1.34	0.06	0.36
	Mean	0.22	0.19	2.05	1.64	0.10	0.30
VA 81B	22/18	0.20	0.17	1.43	1.39	0.54	0.54
	26/22	0.28	0.28	1.68	1.61	0.46	0.42
	30/26	0.21	0.22	1.52	1.39	0.29	0.48
	Mean	0.23	0.22	1.54	1.46	0.43	0.48
	Overall mean	0.22	0.21	1.67	1.57	0.31	0.45
SEDs to compare overall mean of:							
a) G over T and P (Df = 12)		0.017		0.025		0.048	
b) P over G and T (Df = 5)		0.018		0.057		0.018	
c) T over G and P (Df = 5)		0.022		0.069		0.023	
d) T effects at a given level of P and G		0.048		0.111		0.010	
e) P effects at a given level of T and G		0.048		0.111		0.010	
CV (%)		20		11		31	

(Bhagsari, 1974). The intercepted radiation was not measured in the present study but leaf area per plant provided an estimate of canopy cover. Mutual shading of leaves across genotypes were minimal since single plants were grown in pots.

LD conditions favoured leaf area development (Table 2) which accounted partly for (44 %) the variation in production of TDM (shoot+root+pods) (Fig. 1a). However, about 76 % of variation in shoot+root dry matter production was accounted for by the variation in leaf area (Fig. 1b). Lack of relationship of leaf area with either pod number (Fig. 2a) or pod dry weight (Fig. 2b) suggested that the reproductive development was being controlled by factors other than carbon assimilation. The stimulation of dry matter production in LD conditions might be due to preferential allocation of assimilates to leaf growth, relative to other storage organs, as observed in groundnut (Ketring, 1979, Witzenberger et al. 1988) and other crops (Solhaug, 1991).

Analysis of reproductive efficiency indicated that the effect of temperature on reproductive development starts during the vegetative phase itself by influencing the proportion of reproductive nodes in the total number of nodes, with RNR being generally high at 26/22°C (Table 4). The photoperiod effect became significant on development of pegs into pods as indicated by a reduction in PPR by 30 % in TMV 2, 67 % in NC Ac 17090, and 10 % in VA 81B, under LD conditions (Table 4). However, the effects of photoperiod treatments were significant at the high temperature regime (30/26°C). Further, effects of photoperiod and temperature were evident on partitioning of dry matter to shell relative to seeds. Shell dry weight was greater (for TMV 2 and VA 81B) under LD than SD, but declined at the two extreme temperatures, particularly under both photoperiod treatments (Table 2). Seed weight also significantly reduced under extreme temperatures and photoperiod effects were apparent only at high temperature regimes.

There is very limited information on temperature × photoperiod × genotype interactions (Bagnall and King 1991, Nigam et al. 1994) on reproductive processes. The present study suggests that the photoperiod effects operate only above a certain critical temperature which lies in between 22/18°C and 26/22°C regimes. This observation is in agreement with Yan and Wallace (1996) who

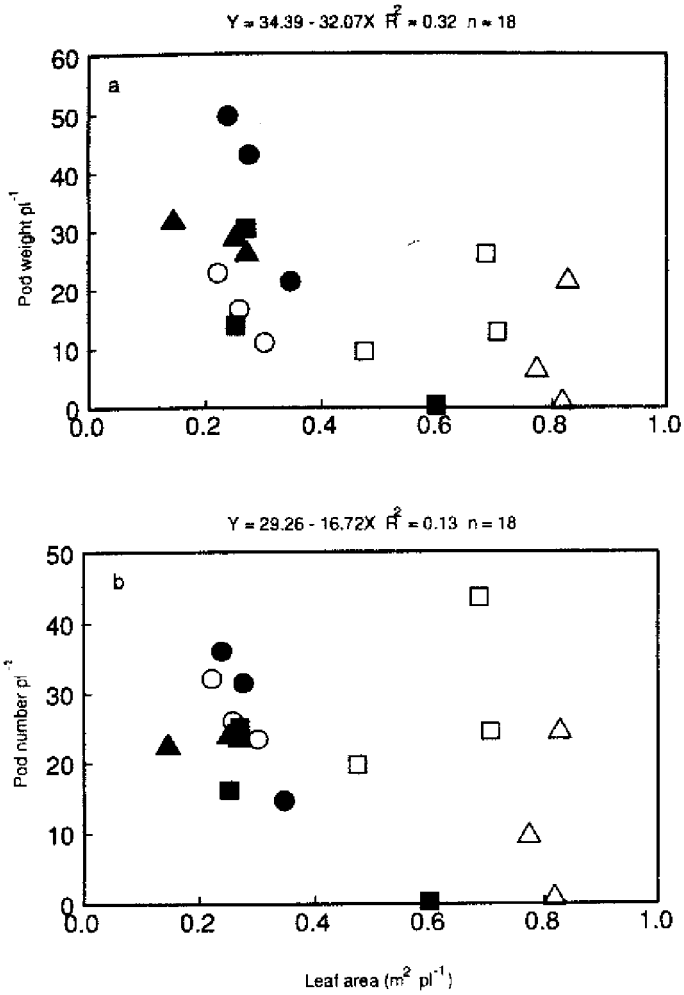

Fig. 2: Relationship between leaf area and pod weight (a) and pod number per plant (b) in TMV 2 (□), NC Ac 17090 (○) and VA 81B (△) genotypes grown under LD (open symbols) and SD (filled symbols) photoperiods and three temperature regimes

suggested that there might be a base temperature below which photoperiod gene activity does not occur. There is little information on the critical temperature requirement for expression of photoperiod effect in groundnut.

Earlier studies highlighted the importance of photoperiod in genotypic adaptation in groundnut (Wynne et al. 1973, Witzenberger et al. 1988, Bagnall and King 1991, Nigam et al. 1994). These studies also showed genotype × photoperiod interaction in partitioning of dry matter to pods which was the process most sensitive to photoperiod. However, partitioning of dry matter of pods is an integrated effect of various physiological factors such as sink size and preferential diversion of dry matter to other organs, as opposed to growing reproductive structures. In addition to photoperiod, partitioning of dry matter to pods in groundnut is also influenced by abiotic factors such as water deficits (Nageswara Rao et al. 1985), calcium availability (Rajendrudu and Williams 1987), boron deficiency (Cox and Reid 1964) and aluminium toxicity (Gani et al. 1992). Significant genotype × environmental interaction has been observed for these abiotic factors. Therefore, partitioning, which involved both development and growth of reproductive structures, is a result of various factors integrated over time; thus, it may not be an absolute measure of photoperiod sensitivity in groundnut.

Results from the present study suggest that pod to peg ratio was most sensitive to photoperiod at and above the 26/22 °C temperature regime. Since photoperiod effects operate only above a certain critical temperature which seems to lie in between 22/18 °C and 26/22 °C, the PPR could serve as an easy and effective indicator in identifying photoperiod sensitivity in groundnut genotypes at and above 26/22 °C. The use of PPR as an index can avoid confounding effects of soil nutrient disorders on pod growth (thus partitioning).

Zusammenfassung

Einfluß der Temperatur und der Photoperiode auf das vegetative und reproduktive Wachstum von Erdnuß (*Arachis hypogaea* L.)

Einflüsse von Temperatur und Photoperiodeinteraktion auf das vegetative und reproduktive Wachstum wurden bei drei ausgelesenen Erdnußgenotypen unter kontrollierten Umweltbedingungen in Wachstumskammern für drei Temperaturbereiche (22/18, 26/22 und 30/26 °C Tag/Nacht) unter Langtag (12 h LD) und Kurztag (9 h SD) Photoperiode untersucht. Der Einfluß der Photoperiode auf die Gesamttrockenmasseproduktion (TDM) war signifikant wirksam für die Genotypen, wobei eine um 32–72 % höhere Trockenmasse unter LD als SD produziert wurde. Temperatur und Genotypinteraktionswirkungen waren signifikant in der Trockenmasseproduktion am größten bei 26/22 °C und am geringsten bei 30/26 °C und 22/18 °C für zwei von den drei Genotypen. Die Blattfläche (LA) war unter LD größer als unter SD in allen Temperaturbereichen. Die LA war für 76 % der Variation im Sproß- + Wurzeltrockengewicht verantwortlich ($R^2 = 0{,}76$, $P < 0{,}01$). Der Mangel einer Beziehung zwischen LA und Hülsengewicht oder Hülsenanzahl läßt vermuten, daß die Hülsenentwicklung von anderen Faktoren als der Kohlenstoffassimilation kontrolliert wird. Die Temperatur × photoperiodische Interaktion war signifikant wirksam bezüglich des Wurzelwachstums mit einem maximalen Wurzelgewicht und photoperiodischen Wirkungen minimal bei 22/18 °C, während bei 26/22 °C das Wurzelgewicht abnahm und die photoperiodischen Wirkungen überwogen. Niedrige

Temperatur (22/18 °C) beeinflußte die reproduktive Entwicklung über eine Reduzierung der Anteile reproduktiver Knoten an der Gesamtknotenanzahl (vegetative + reproduktive). Die Umbildung von Blüten in Hülsen, bestimmt als Hülsen zu Blütenverhältnis (PPR) war geringer unter LD-als SD-Bedingungen. Die Ergebnisse weisen darauf hin, daß PPR angewendet werden kann als Indikator für genotypische Sensibilität gegenüber der Photoperiode bei Erdnuß.

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