The Bean Program concentrates its resources primarily on genetic improvement Specific studies are needed to support this principal activity Studies reported this year include one comparing grain production efficiencies of *Phaseolus vulgaris* and eight other legumes preliminary results in defining yield models of the four growth habits of *P vulgaris* calculation of phenology models of *P vulgaris* and bean performance under stress and non-stress con ditions [1]

Comparisons of Grain Legume Species

Grain legumes are morphologically similar in that the basic building block of the plant is a nodal unit with leaf and pod attached A comparative experiment was conducted at CIAT Palmira to evaluate the yield efficien cies of *P vulgaris* and eight other legume species A similar experiment with five legumes was reported two years ago (CIAT Ann Rept 1978)

The best adapted genotypes for most of the species were selected from previous yield trials The trials included materials available from international and national programs The climatic conditions at CIAT Palmira are considered sufficiently moderate (mean temperature 23 8 C) that no species was at a disadvantage *Phaseolus coccineus* was not included as it is relatively unadapted at local temperatures

Mean species grain yield ranged from 2 2 to 4 5 t/ha (Table 1) Leaf area duration (LAD) days to maturity and total biomass were all highly and positively correlated with yield

Common beans were intermediate in yield and unlike some other species (e g *Vigna* spp) were highly syn chronized with pod maturity Harvest index and yield/LAD were comparable with soybeans and higher than those of other species The difference in crop growth rate (CGR) between soybeans and common beans was consistent with the difference in maximum leaf area index (LAI) A detailed comparison of growth parameter trends with time for one cultivar each of common beans (Porrillo Sintetico) and soybeans (ICA Tunia) indicated that growth patterns for the two species are similar (Fig 1) However common beans mature much earlier and thus have lower LAI and CGR values Peak grain growth rate (GGR) is much higher in beans and the grain growth phase is proportionally much shorter

While soybeans commenced flowering at the same time as beans the post flowering phase was much longer The soybean cultivar had a longer flowering period due to the extra nodes on the main stem which must go through the flowering process

The grain filling process in soybeans proceeds at a lower maximum rate and is spread over a longer period than common bean (Fig 1) The rate of decline in LAI during senescence is slower in soybeans

Common beans apparently adjust potential sink size (pod number) to the available source (leaf area) and then proceed to fill the sink (grain growth rate) as quickly as possible

Soybeans continue their high GGR during the period of senescence This suggests that the common bean is more efficient than the soybean in its use of assimilates produced by photosynthesis

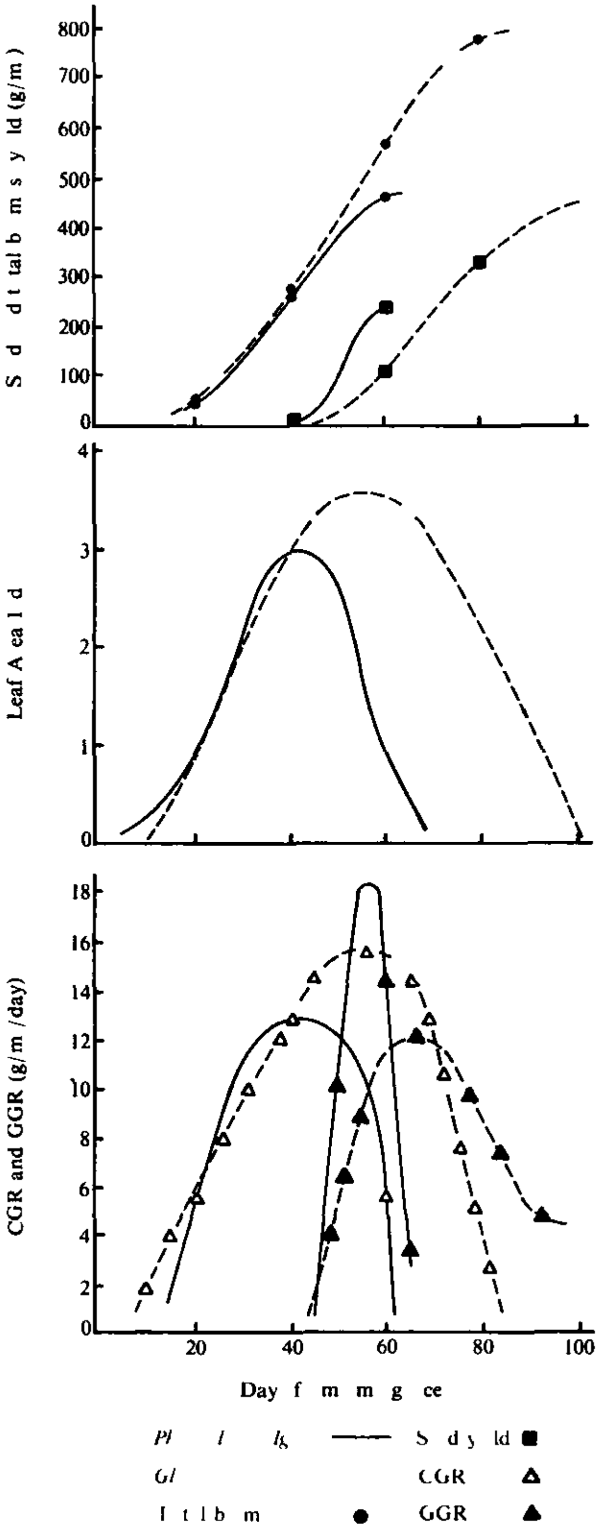
Seed yield versus LAD for each of the 16 genotypes tested is plotted in Figure 2 *Arachis hypogea* (peanuts) is the only species in the list with a different morphology The data are remarkable in that one variable (LAD) can be used to explain a large proportion of the yield variation of 15 genotypes from four genera and eight species Since all of the species are constructed with similar building blocks it can be concluded that yield among grain legumes is simply related to the number of nodal units present which is in turn chiefly a function of time

R P J 1971 A comp t program f fitting n-linea gression mod ls t d t by least squares. A ral C mm w lth Sc f d I d ial R se h O ga iza (CSIRO) D S I F h P p 6 Tyld ley J B 1978 A method of aluat g the ffect f t mper tu on an ganism wh th esponse is n-linear Ag M I 19 137 153

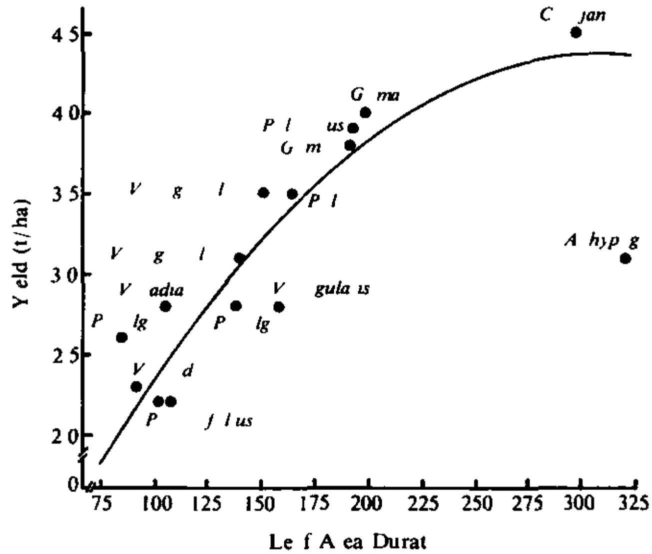
T bl l G y ld d alu f sele ted y ld comp nt fo m l gume sp es

Sp nd (mb f ge typ)	Y ld (14 %)		Y eld/day	Numb f days to		Ma mum Leaf Are Ind x LAI	C p G wth Rate at max LAI	Leaf A e D at n LAD	Y eld/LAD	T tal b ma	Harvest d
	(kg/ha)	t f rst harvest (%)	(kg/ha/day)	fl w g	matu ty		(g/m /day)		(g/m /day)	(kg/ha)	(%)
Caj us j (1)	4479	68	26	67	174	5 2	10 1	298	1 5	9400	41
Gl m (2)	3899	100	38	34	102	4 2	14 9	195	2 0	5440	62
Ph l lu t (2)	3682	68	26	35	139	3 6	8 5	179	2 1	5990	53
V gn ngu l t (2)	3292	82	30	43	109	4 0	8 7	147	2 2	6145	46
A his hyp g (1)	3080	100	27	28	114	6 0	13 8	323	1 0	5570	48
Ph l lg us (3)	2637	100	34	35	78	2 8	10 0	108	2 4	3733	61
Vig d at (2)	2533	83	26	38	99	3 0	10 8	99	2 6	4295	51
V gn g lar (1)	2748	100	31	35	88	4 0	14 3	158	1 7	3930	60
Ph l tf l (2)	2170	100	29	39	76	3 6	12 4	105	2 1	3125	60
L S D (0 05)	277		3	4 9	23 7	2 9	6 9	25	1 0	1428	3 8
C V (%)	9 4	9 4	9 9	1 4	3 1	14 3	11 9	16 0	2 4	16 7	5 8
alue (y ld)				0 56	0 86	0 50	-0 16	0 93	—	0 91	—

I t g d d LAI rv (m g ce phy l g cal m y)
Dry eed y ld/ l b m m l p l t m y
W h *A h p g*



Fg 1 G th p m t for ne **Phaseol ulgaris** ty (P llo S t t) d ne **Glycin m** a ety (ICA Tun) (C r d d f m t go m t curv f tt ng p du)
CGR = C p G wth Rat GGR – G n G th R



Y = 0 028X – 0 00005X

Figu e 2 *S d) ld (14% m istu e) sus Le f A Du t o nt g t d f om m g n t phy l g lm tu ty f 16 g notype of ght l g m p (–0 997 w thout* **A hypogea** *0 93 th* **A hypogea**)

Growth Habit Yield Models

The relationship between morphological and physiological factors and grain production was studied in preliminary experiments Forty lines varying in the length of their preflowering vegetative growth phase and seed filling time and seed size were selected for each of the four growth habits of *P vulgaris* The selection was done to obtain the variation that exists in the germplasm within each habit

Table 2 shows the means and ranges of selected yield components and yield for each growth habit Similar data have been reported in earlier annual reports however this study concentrates on the variation obtained within each growth habit and the basic data on which the eventual models are to be built Leaf area index (LAI) crop growth rate (CGR) days to flower and number of nodes were chosen as the basic components of the model All of these components except CGR increase from growth habit I to IV The other components do not vary so much or show trends for the mean values The ranges of each component do vary depending upon the growth habit

Yield models were designed for each growth habit The general form of the models is illustrated in Figure 3 Details within habits are discussed separately since the yield models differ depending upon the growth habit

Table 2 Mea s a d ges of selected mo phologıcal ompo ts of 401 es f om each growth habit of *Phaseolus vulgarıs*

	G owth h b ts							
	I		II		III		IV	
	Mea	Ra g	Mean	Range	Mean	Range	Mean	Range
Y ld (kg/h)	1066	(164-1436)	1376	(795 2058)	1377	(406 2056)	1366	(507 2053)
N mbe of s ed /m	423	(97 1002)	789	(147 1442)	761	(354 1187)	668	(132 1102)
We ght/seed (g)	0 25	(0 12-0 45)	0 18	(0 14-0 31)	0 18	(0 22-0 33)	0 24	(0 14-0 47)
Numbe of pod /m	136	(39 240)	190	(72 313)	173	(107 270)	153	(62 267)
Se ds/pod	3	(2-4)	4	(2-6)	4	(3-6)	4	(2-6)
N mbe f odes/m	356	(224-565)	425	(263 586)	476	(318 719)	583	(417-832)
P d / ode	0 4	(0 1-0 8)	0 5	(0 2-0 7)	0 4	(0 2-0 6)	0 3	(0 1-0 5)
D y t fl w	28	(24-44)	32	(27 38)	33	(24-39)	32	(24-38)
Seed f ll g tıme	40	(30-49)	39	(32 50)	41	(28 53)	52	(44-58)
L af area de (LAI)	2 7	(1 7-4 2)	2 9	(1 3-4 8)	3 3	(1 9 5 4)	3 5	(2 2-6 0)
C p g owth ate (CGR)	10 3	(5 0-20 6)	10 8	(5 2 22 9)	9 8	(6 1 17 4)	10 6	(5 5 24 7)
N d g owth rat (NGR)	5 3	(2 9-8 3)	6 0	(3 7 8 5)	6 4	(4 1 9 3)	7 0	(5 5 9 4)
Gra g owth t (CGR)	4 8	(0 7 10 8)	5 6	(2 4 11 6)	5 7	(2 3 10 5)	5 7	(2 1 10 1)

D y t m fl g phy l gıcal ma ty
g/m /d y

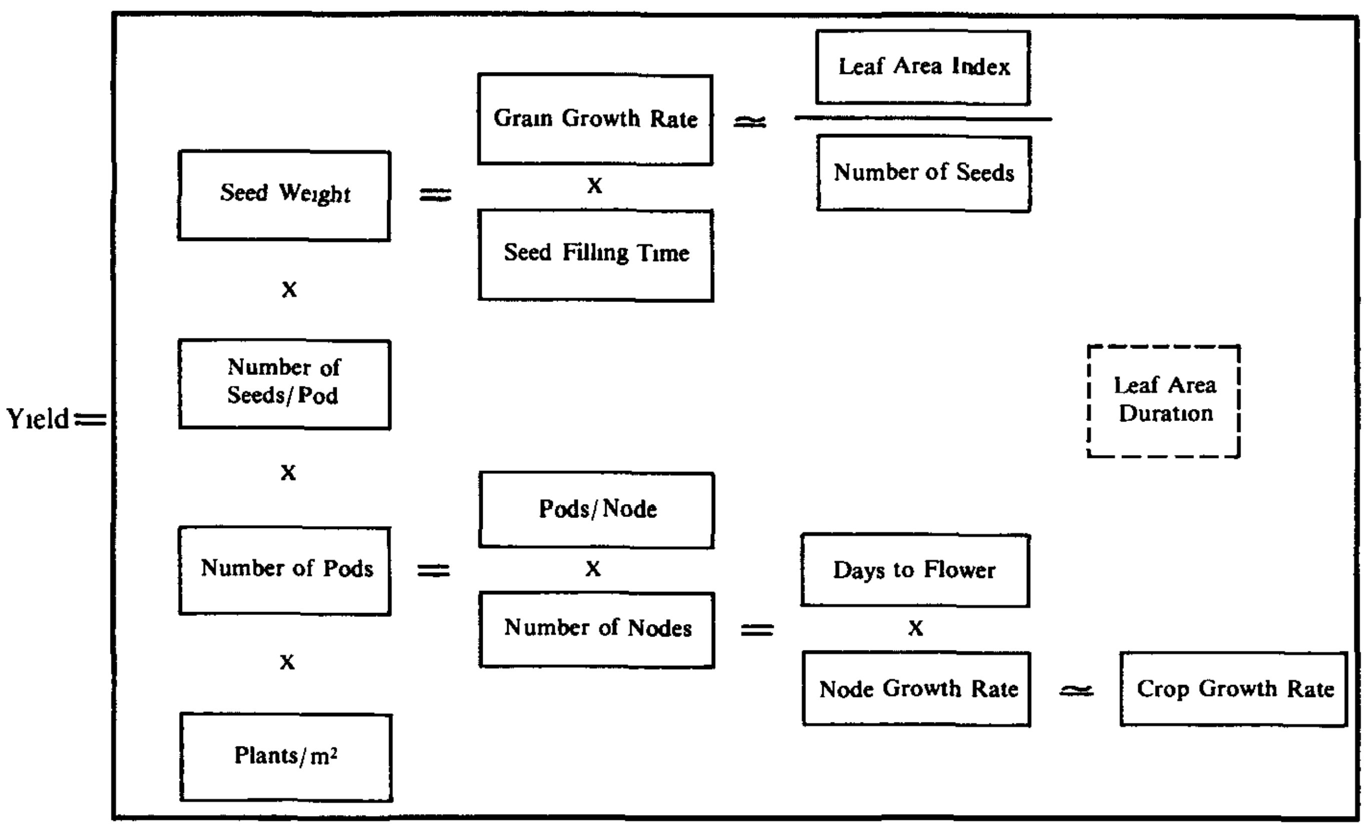


Fıgure 3 *P l m n y g e l y eld m del f le t d g wth p m t fo the f u* **Phaseol** *vulg g owth h b t*
G wth hab t I only

Growth habit I Number of total seeds number of pods number of seeds per pod number of pods per node CGR and grain growth rate (GGR) are all correlated with yield (Table 3) Days to flower is negatively correlated to yield

Table 3 Correlation coefficients of grain yield with various yield components for four growth habits of *Phaseolus vulgaris*

Morphological Component	Growth habit			
	I	II	III	IV
Number of seeds/m	0.51	0.91	0.54	0.84
Weight/seed	0.26	-0.44	0.16	0.46
Number of pods	0.56	0.74	0.51	0.65
Seeds/pod	0.41	0.66	0.51	0.63 *
Number of nodes	-0.15	0.41	0.18	-0.13
Pods/node	0.49	0.60	0.60	0.66
Plants/m	0.05	0.21	0.20	0.46
Days to flower	0.55	0.10	0.01	0.24
Seed filling time	-0.06	-0.17	-0.28	-0.26
Leaf area index (LAI)	0.08	0.42	0.33	-0.07
Crop growth rate (CGR)	0.47	0.50	-0.01	0.24
Node growth rate (NGR)	0.23	0.43	0.07	-0.10
Grain growth rate (CGR)	0.37	0.64	0.19	0.58

The length of the preflowering vegetative phase does not have an effect on the number of nodes formed but is correlated (47**) to the leaf area duration (LAD) LAD is negatively correlated (50) to the number of pods per node which does have a strong relationship with the final yield Seed size is negatively correlated (57**) to the number of seeds per pod Since number of seeds per pod is highly correlated to yield selection for a large seed size in this growth habit can also be a selection for lower yields According to the early model for this growth habit selection for a plant with many nodes a long preflowering vegetative phase and an increased number of seeds per pod should result in selection for higher yields The large number of nodes is essential to provide sites for pod and leaf formation

Growth habit II All yield components except seed size days to flowering and the length of seed filling period are correlated to yield (Table 3) Seed size as in growth habit I is negatively correlated to yield and to the number of seeds per pod (55***) Therefore a selection for large seed size can result in fewer seeds per pod and can also be a selection for lower yield This is the only growth habit showing a correlation between maximum LAI and yield This is due to the direct relationship of LAI with GGR and the number of seeds per pod The correlation (61* *) between plants/m^2 and the number of nodes suggests that plant density for this growth habit can affect final yield The growth habit II model implies that both the LAI and the number of nodes are the major limiting factors towards increased grain production

Growth habit III The yield components correlated with yield are the number of total seeds number of pods number of seeds per pod and the maximum LAI (Table 3) The model for this growth habit tends to be less obvious in the selection of yield components for increasing grain production Although LAI is correlated with yield it does not have a direct relationship with any yield components used in this model

The model does however suggest that selection for more nodes or large seed size can also be a selection for low yield The lack of relationship between GGR and final grain yield and negative correlation (-40**) with pods per node suggest that leaf area is limiting to support pod formation and pod filling

Growth habit IV This growth habit differs from the others in that seed size and number of seeds per pod are correlated to yield (Table 3) Even though seed size and number of seeds per pod are negatively correlated (57**) to each other selection for both large seed size and more seeds per pod should result in higher yields A negative correlation (57) existed between GGR and the length of the seed filling period Since GGR is correlated to yield this suggests that shortening the period from flowering to physiological maturity could be beneficial

General observations In all growth habits except IV selection for large seed size without enough seeds per pod can result in a selection for lower yields Since these models are in the early stages of development it is not known whether the limits of seed size will have detrimental effects on the number of seeds per pod

The number of pods per node or the number of total pods for all growth habits except type I were correlated with yield There was no direct relationship between these two parameters with LAI and LAD implying that there is sufficient leaf area to support the growth of pods

In growth habit I LAD needs to be increased either by increasing the maximum LAI or the time to physiological maturity However for growth habit II a relationship (56 **) existed between LAI and GGR suggesting that leaf area is limiting in the filling of these pods

It should be noted that changing one of these components will of course increase or decrease that component s or other components effects on grain production The limits at which a component can be changed before it will cause other factors to become yield limiting are unknown

In order to evaluate the suitability of a new line or cultivar for a particular region its expected phenology must be known Since the phenologic response depends upon temperature and photoperiod it is essential to have a model that predicts the effects of these variables

Such a mathematical model was developed by the Physiology Section of the Bean Program The derivation and form of the model are not presented in this report but results from testing the model will be described

Data for testing the model were those available from growing a common set of 20 cultivars in the 1976 International Bean Yield and Adaptation Nursery (IBYAN) at 39 international locations The flowering similarity of the 20 cultivars had been evaluated previously by comparing their performance at 27 world locations with independent tests of their photoperiod sensitivity at CIAT Palmira (CIAT Ann Rept 1978) In constructing the current model the estimated critical daylength was increased to 13 hours 30 minutes (materials had been tested at CIAT Palmira under a normal daylength of 12 hours 20 minutes and an extended daylength of 18 hours) After the earlier evaluations materials were placed in cluster groups according to their phenologic behavior at world locations

By applying the model to these previous groupings reasons for their behavior became evident (Table 4) In the table the photoperiod response class and cluster groupings in the columns at the right are those determined from the earlier analyses The coefficient of photoperiodicity was calculated from the model It is at or near 0 when there is little or no flowering delay as daylength increases above the critical point (i e the photoperiod response is essentially

Tabl 4 P m t t m t f fl w g m d l mp d t l t nalys s based o fl weri g ph ology t th 1976 I t t l Bea Y ld and Adaptat o Nursery (IBYAN) locat o

M mum day t fl w g B0	C ff t f ph t pe d ty B1	Base t mp t (C) B2	B3	B4	R t me q a e o (days)	Phot peri d espo se class	Cl t g p	Be m t ri l
Normal temperature espo se								
34	008	11 0	23 7	27 5	3 8	3N	1	G4495 (P566)
37	027	11 7	20 7	28 7	4 2	3N		G3834 (P560)
36	011	11 1	22 2	28 3	4 4	3N		G4451 (P757)
38	030	10 6	20 8	29 0	3 8	3N		G4454 (P458)
38	0	11 1	20 6	29 0	3 8	1N	2	G3645 (P459)
38	0	11 8	20 4	30 4	3 9	1N		G4525 (P675)
38	0	11 5	20 1	29 3	4 2	1N		G1820 (P302)
39	014	11 0	20 6	29 0	3 8	2N	3	G4122 (P512)
40	0	11 0	20 5	29 6	4 2	2N		G4421 (P524)
Mi ed temperature esp se								
34	0	8 5	26 0	26 1	4 3	1N	4	G4459 (P643)
40	027	10 2	20 7	28 6	4 3	2N	5	G3776 (P539)
36	001	11 9	20 3	27 5	5 3	2N	6	G3353 (P498)
37	019	11 6	20 0	28 0	4 6	2N		G4446 (P758)
38	127	5 1	17 7	28 0	5 9	4A	7	G4523 (P637)
37	028	10 2	21 0	29 8	3 6	3N	8	G3807 (P402)
Broad t mperatur esp								
37	0	14 4	16 2	34 0	3 5	1N	9	G4445 (P756)
35	0	14 8	16 3	34 0	3 1	2N		G4498 (P392)
35	073	11 9	16 0	31 8	2 8	4A	10	G4494 (P692)
35	056	12 7	16 0	34 0	2 9	4A		G4460 (P755)
33	0	14 3	17 0	33 3	4 0	1N	11	G0076 (P759)

D d g m b d b d ph l gy

Ph p od l l <4 d y fl g d l y 18 h rs (h) mp red t 12 h 20 m 2 4-10 d y 3 11 20 d y 4 21 30 d y 5>30 d y N rmal fl w g (in 18 h) wh fl w g mm ce A b rm l fl w g h bsc ss neutral) this value approaches 1 as a material becomes more sensitive to photoperiod The base temperatures beta 2 beta 3 and beta-4 are also parameters of the model They are those temperatures that respectively indicate the point where a cultivar shows an initial response to temperature where temperature response reaches a plateau and where the higher temperature causes a decrease in cultivar performance From the original cluster patterns it is possible to see that groups 1 2 and 3 formed a discernable pattern after that however response types became numerous and varied The new model indicates that a variety of temperature response were the causes

The first three groups comprise a temperature response type here called normal At the bottom end of the cluster groups are several with varied photoperiod responses but a readily identifiable temperature response type called the broad response is due to the wide temperature plateau Between these extremes is a group of cultivars with mixed responses Given the possible sources of error in reporting phenology data from a large international network the root mean square (RMS) errors of about four days confirm that the data and the model rather accurately describe the interactions of temperature and photoperiod in bean cultivar performance The results are important in that they open the way to possibly estimating the model parameters from simple (and presently routine) screenings at CIAT stations This would enable predicting the phenology of both existing cultivars and new lines for the full target area and thus aid in determinig their suitability for any location

Plant Development under Leafhopper Stress

Tabl 5 Y ld d selected growth param te f l ary g n the tol ra ce to *Emp* k m u d p tect d d p te ted cond t o s

P am te	P tected			U p tect d			L S D (0 01)
	Tol ant	I t rm d at	Suscept bl	Tol ra t	Int mediat	Suscept ble	
Y eld (kg/ha)	2000	1610	1948	1067	846	816	16
Y eld/day (g/m /day)	2 8	2 3	3 0	1 5	1 2	1 2	2
Number f pods/m	299	254	335	267	248	261	38
Numbe of nod /m	581	422	453	595	492	482	70
Leaf area index (LAI)	4 9	5 0	4 2	3 5	4 1	2 6	0 7
Leaf area du t (LAD)	173	154	137	119	126	79	12
Y eld/LAD	1 1	1 0	1 5	0 9	0 7	1 0	0 1
Crop growth t (CGR)	16 7	13 0	15 6	12 1	12 4	8 8	2 9
Grain growth rate (CGR)	6 9	5 9	7 3	4 1	2 8	3 5	1 3
Stem lenght (cm)	106	66	67	64	53	49	10
B mass (kg/ha)	3671	2661	3316	2261	1916	1615	52
Harvest dex (%)	44	46	44	42	43	42	7
N mber of *Empoas* ymphs	0	0	0	117	155	132	N S
Numbe of *Empoas* adults	0	0	0	679	559	591	60

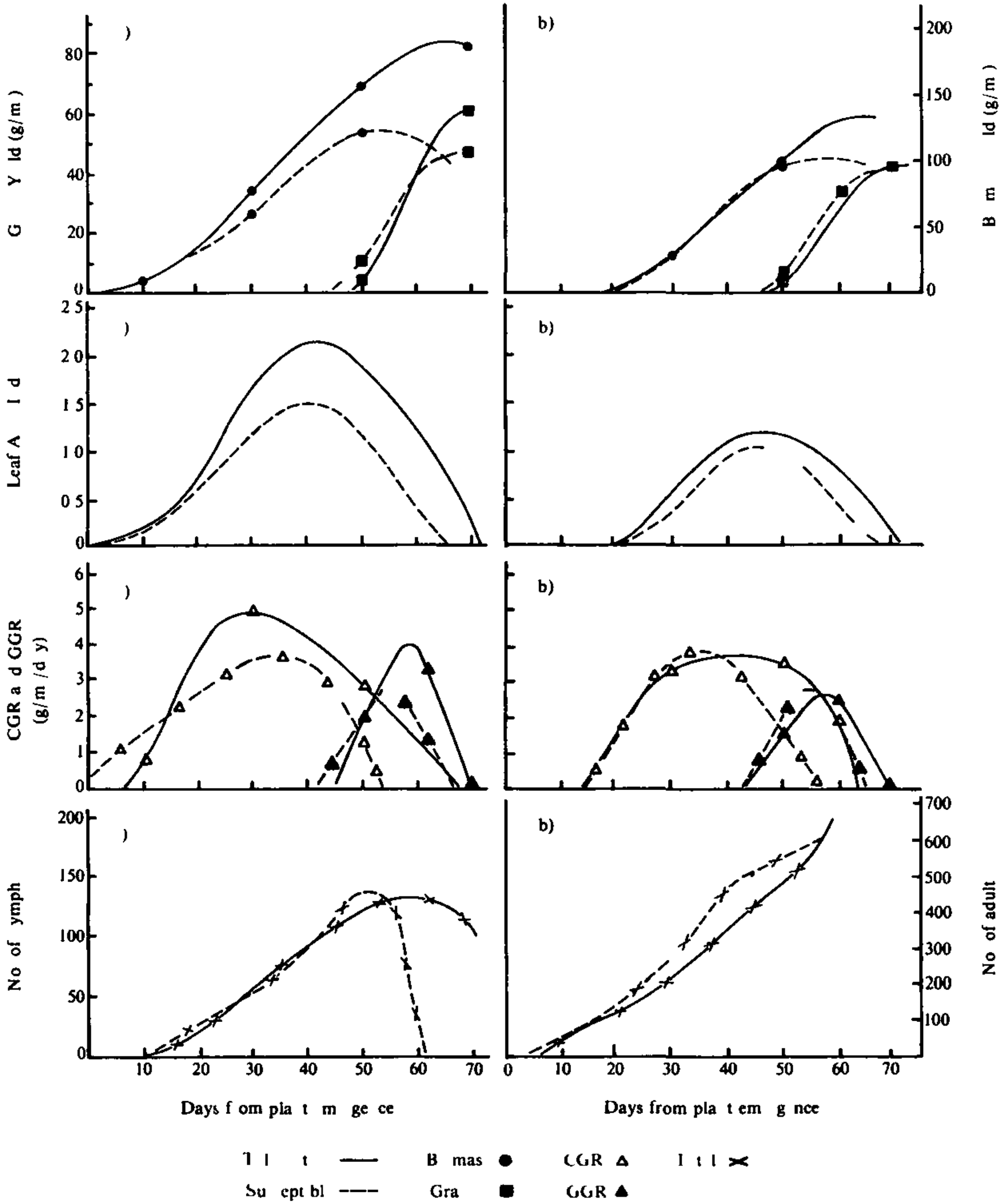
T l rant li EMP 9 G0124 I med li ICA Tui S scept bl l ne BAT 41 B

V l es w h asterisk sh wed g f ca d ff re ce (P 0 01) be wee l ra d uscep bl lines nd p tected nd ns N S g i ca

An experiment was conducted to study the effects of the leafhopper *(Empoasca kraemeri)* on bean yield com ponents and final grain yield Two tolerant lines (EMP 9 and G 0124) two susceptible lines (BAT 41 and Bunsi) and an intermediate line (ICA Tui) were grown in protected and unprotected plots at CIAT Palmira

Yield and most of the major yield components decreased significantly from protected to unprotected treatments regardless of whether lines were tolerant or susceptible (Table 5) Significant yield reductions of 47% for tolerant lines and 59% for the susceptible lines were recorded Yield differences were due to decreases in the number of nodes leaf area index (LAI) and leaf area duration (LAD) Only in the later plant growth stages did leafhopper nymphs and adults show different preferences between tolerant and susceptible lines

Figure 4 compares curves for the different growth parameters and insect populations all insect population curves represent total counts per plant The nymphal population curve for the tolerant lines remained high because the vegetative material (measured by LAI and total biomass) decreased less during this period compared to the susceptible lines The nymphal population on tolerant lines began to drop when plants reached physiological maturity LAI and total biomass then decreased rapidly from insect feeding Adult populations increased rather steadily in both tolerant and susceptible lines Only after the susceptible lines were severely damaged did insects migrate



F g 4 *G o th p m t f m in t m and b n h of* **Phaseolus ulgaris** *l ne tole ant nd us ptible to* **Empoasca kraem ri** *(C d df m t ig n met cu f ti ng p ed) CGR= C op G owth Rat GGR=G n G th R t) St ms b) B an h* to the green growth of the tolerant lines shown by the significant increase in the number of adults near the end of the season

The sudden decrease in total biomass production and crop growth rate (CGR) for the susceptible lines coincided with peak nymphal populations Stem LAI but not branch LAI decreased significantly between tolerant and suscepti ble lines Due to this lack of leaf area grain growth rate (GGR) also decreased on stems but not on branches

Plant Development under Low Input Stress

Yield parameters in beans were also studied under high and low levels of inputs High inputs included complete control of insects and diseases and applications of fertilizer at planting low inputs involved only applying a small amount of fertilizer at planting (Table 6)

Yield differences on both stems and branches were significant between the two treatments An interesting point was that seeds were larger but not significantly so for low input treatments This probably was due to the significant decrease in seeds per pod These two parameters were shown to be negatively correlated in the earlier discussion on yield modeling

The data in this experiment suggest that a major cause for decreased yield under low inputs is the number of seeds per pod and that most of the yield loss may be traced to low yield on branches

Table 6 Relat n h p f selected y eld ompo ent to bea y eld f *Phaseolus vulg* is lines rece ing two levels of p t

Y ld component	I p t l l		L S D	Value (us y ld)		C V
	High	Low		High puts	Low p ts	(%)
Y ld (g/m)						
stem	100	65	17	46	46**	21 2
branch	84	54	19	20	37	28 2
t tal	184	119	35			14 1
Pod umber/m						
stem	125	100	70	31	41	19 5
branch	106	89	76	01	34	24 4
total	231	189	108	23	46	16 1
Seeds/pod						
stem	4 7	2 1	1 6	40	17	11 9
bra ch	4 2	2 1	2 2	49	27	17 2
total	4 5	2 1	1 5	51	26	11 4
Weight (g)/100 seeds						
stem	19	31	22	19	05	27 0
branch	19	28	18	21	04	23 9
total	19	30	19	20	03	24 0
Biomass (g/m)						
t m	210	127	42	31	36	15 9
bra ch	137	86	44	04	20	21 3
total	347	214	63	25	36	15 8
Harvest index (%)						
t m	51	57	12	28	38	14 9
bra h	62	68	13	21	38	13 5
total	55	61	11	28	41	12 6
Y ld/day (g/m)						
tem	1 5	1 1	9	44	46	14 3
bra ch	1 1	1 0	9	19	37	18 7
total	2 5	1 5	9	98	99	14 7
Days to fl w	37	37	4	04	06	7 3
Days to m t rity	75	81	5	01	02	4 2

H gh inp is f reg la p y g f sect nd dise ses as w ll f rt lize pla ing L w p t nsist ly f an ppl cat f l w m t f f ilize t pla ting

H gh p l wi h as risk were ignificantly diff re t f m th mparable l w p t lue

Appendix A

Description of *Phaseolus vulgaris* L Growth Habits

Type I Determinate growth habit reproductive terminals on the main stem with no further node production on the main stem after flowering commences

Type II Indeterminate growth habit vegetative terminals on the main stem with node production on the main stem after flowering commences erect branches borne on the lower nodes of the main stem erect with relatively compact canopy variable guide development depending on environmental conditions and genotype

Type IIIa Indeterminate growth habit vegetative terminals on the main stem with node production on the main stem after flowering relatively heavily branched with variable number of facultatively climbing branches borne on the lower nodes variable main stem guide development but generally showing climbing ability

Type IIIb Indeterminate growth habit vegetative terminals on the main stem with node production on the main stem after flowering, relatively heavily branched with variable number of facultatively climbing branches borne on the lower nodes variable main stem guide development but generally showing climbing ability

Type IVa Indeterminate growth habit vegetative terminals on the main stem with heavy node production after flowering commences branches not well-developed compared to main stem development moderate climbing ability on supports and pod load carried evenly along the lenght of the plant

Type IVb Indeterminate growth habit vegetative terminals on the main stem with heavy node production after flowering commences branches not well-developed compared to main stem development strong climbing tendency with pod load mostly borne on the upper nodes of the plant

Notes The growth habit classification has been expanded for the climbing types since the 1977 Annual Report Type III materials with some tendency to climb are now recognized as Type IIIb,and Type IV has been divided on the basis of vigor and pod distribution

The most important distinguishing features of the growth habits are as follows terminal raceme on main stem for Type I indeterminate with erect branches for Type II indeterminate with prostrate branches for Type IIIa indeterminate with semi-climbing main stem and branches for Type IIIb indeterminate with moderate climbing ability and pods distributed evenly up the plant for Type IVa indeterminate with aggressive climbing ability and pods carried mainly on the upper nodes of the plant for Type IVb

Growth habit is not necessarily a stable characteristc since changes in growth habit may occur from one location to another The classification of growth habit for a particular genotype is only useful in a defined environment particularly with regard to climbing ability

Appendix B

CIAT Accessions of *Phaseolus* Referred to in this Report

CIAT No	Identification	Local register	Source[2]
G00057	Swedi h Brown	PI 136735	USA
G00076	Red Kloud		USA
G00118	Forty Days	PI 162566	USA
G00124		PI 163372	USA
G00159	Cali Fasulya	PI 165078	USA
G00489	Raytal	PI 175269	USA
G00687	Windsor Long Pod	PI 182026	USA
G01507	Ojo de Cabra	PI 281988	USA
G01820	Negro Jamapa	PI 309804	USA
G01854	Nima	PI 310512	USA
G02005		PI 310739	USA
G02006		PI 310740	USA
G02047		PI 310805	USA
G02 58	Morada del Agua	PI 311904	USA
G02333	Colorado de Teopisca	PI 311998	USA
G02525	Magdalena 3	PI 313624	USA
G02618	Col No 168	PI 313755	USA
G02858	Zacat cano	PI 319665	USA
G02959	Pecl o Amarillo	GTA-014	GTA
G03353	Puebla 152		MEX
G03607	C C G B-44	I-462	VNZ
G03645	Jamapa	I-810	VNZ
G03652	Puebla 152	I-820	VNZ
G03658	Mexico 27N	I-867	VNZ
G03776	Venezuela 2	I 1062	VNZ
G03807	Brasil 2 Pico de Oro	I 1098	VNZ
G03834	51051	I 1138	VNZ
G03942	Michelite	B-33	CRA
G04000	NEP Bayo 22	C 286	CRA
G04122	S 166-A N	N 555	CRA
G04393	Tlaxcala 62 C		MEX
G04421	S-630 B	C-63	CRA
G04434	Antioquia 11	P 111	CRA
G04435	Diacol Calima	P 146	CRA
G04445	Ex Rico 23		CLB
G04446	Ex I uebla 152 Brown Seeded		MEX
G04449	Pinto UI 114		USA
G04451	9 Al 2		USA

Append B (cont nued)

CIAT No	Identification	Local register	Source
G04452	ICA Guali		CLB
G04454	ICA Tui		CLB
G04459	NEP 2		CRA
G04460	Pompadour 2		CRA
G04470	Pompadour		DOM
G04482	Zamorano 2		HDR
G04489	Guilapa 72		GTA
G04494	Diacol Calima		CLB
G04495	Porrillo Sintetico		HDR
G04498	Sanilac		USA
G04503	Widusa		FRC
G04505	Top Crop		USA
G04523	Linea 17		CLB
G04525	Linea 32		CLB
G04727	Ancash 66		PER
G04816	Mulatinho		BZL
G04821	Iguacu (Lote 4)		BZL
G04824	Roxão		BZL
G04825	Carioca		BZL
G04830	Rio Tibagi (Lote 10)		BZL
G04978	Amanda —		NLD
G05158	Bico de Ouro 1445	BZL 905	BZL
G05270	Sataya 425		MEX
G05653	Ecuador 299		ELS
G05694	Cornell 49 242		USA
G05702	Cargamanto		CLB
G05708	Sangretoro		CLB
G05743	Preto 897		ATL
G05745	Redlands Greenleaf B		ATL
G05768	Pinto No 650		USA
G05773	ICA Pijao		CLB
G05897	Flor de Mayo		MEX
G06361	Great Northern		USA
G06520	AETE 2	CA 21	UTK
G06719	Jubila		NLD
G06721	Double White		NLD
G07932	Nahuizalco Rojo		ELS
G07951	Aroana		BZL
G09446	Imuna	FRC 542	FRC
G11249	Pinto	IVT 771004	NLD
G11274	B asil 343 Mulatinho	IVT 77039	NLD
G11488	CENA 164-2 CM CM (12 B) F5		BZL
G12631	Ancash 143		PER
G12709	Mortino	Sanudo 45	CLB
G13497	AETE 1/37		BZL
G13499	Petro 132		BZL

Th G od f ccess h mbe ssigned by the germplasm ba k f he CIAT Gene ic R so rces U BAT A EMP BAC DOR d V od bei ng ma ial mp d by CIAT Bea P gram

AIL A I BZL B I CLB C I mb CRA Costa Rica DOM Dom Rep blic ELS El Salvad FRC F GTA (m I HDR H nd ra MEX M PER P UTK U ed Kingd m VNZ V uela