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SELECTION OF CONSISTENT PLANT TRAITS FOR SUNFLOWER GROWTH USING PRINCIPAL COMPONENT ANALYSIS

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SUMMARY

Principal component analysis has been explored for assessing the consistency of 14 plant traits for sunflower growth using multivariate data of 6 field experiments conducted during kharif 1994 to 1999 seasons on rainfed alfisol. Seven genotypes have been used in the study *viz*., Guj-sun-1, MSFH-8, MSFH-17, KBSH-1, Jwala, Pac-36 and Morden. Observations were recorded on leaf nitrogen, leaf area, leaf weight, leaf number, stem nitrogen, stem weight, root length, root weight, stomatal conductance, photosynthesis, total biomass on 30, 45 and 60 days after sowing (DAS) and flower head diameter and flower head weight on 45 and 60 days after sowing in each season. The first two principal components have extracted about 80% of variance in the data of different plant traits on different days after sowing. The consistency of plant traits has been assessed by examining correlations between different plant traits and the distribution of loadings of plant traits on the first two leading principal components 30, 45 and 60 days after sowing.

The results have indicated that stem weight and lead number on the 30th day, leaf area and leaf weight on the 45th day and leaf area, leaf weight and total biomass on the 60th day after sowing had significantly higher loadings on the 1st principal component. Similarly, root length on the 30th day, flower head diameter and flower head weight on the 45th day and root length and photosynthesis on the 60th day after sowing had significantly higher loadings on the 2nd principal component. Based on a graphic plot of the loadings, root length (30 and 60 DAS), stomatal conductance (30, 45 and 60 DAS) and photosynthesis (30 DAS) were found to be consistent since their loadings on the 1st principal component had high mean values with low standard deviations. Similarly, stem nitrogen (45 and 60 DAS), stomatal conductance (45 DAS), photosynthesis (30 DAS), leaf nitrogen (60 DAS), root length (30 DAS), flower head diameter (45 DAS) and flower head weight (45 DAS) were also consistent since their loadings on the 2nd principal component had high mean values with low standard deviations.

Key words: **principal component analysis, plant traits, loadings of traits, sunflower genotypes, dominance for plant growth**

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INTRODUCTION

The growth of a plant is a random phenomenon, which depends on many controllable and uncontrollable variables. The physiological growth of a plant could be measured with different plant traits which are correlated in nature. Smith (1936) developed a model for selecting the best plant traits using Fisher's discriminant function. The theory of selection index based on path analysis has been extended and modified to suit the requirements of plant breeding (Singh and Chaudhary, 1985). Maruthi Sankar *et al.* (1999) have assessed the variability of 8 plant traits for growth of sunflower and reduced the dimensionality to two principal components which extracted about 80% of variance in the original data. Maruthi Sankar (2000) developed a multiple selection index model for assessing the plant growth under dryland conditions. The model has been examined with the data for selection of superior sunflower genotypes which have significantly better performance under moisture stress conditions (Maruthi Sankar *et al.*, 2001a). A methodology for selecting superior sunflower genotypes based on regression procedures has been discussed by Maruthi Sankar *et al.*, (2001b). The selection of superior genotypes for a given environment would invariably require identification of plant traits which are dominant on different days after sowing. The inter-relations of plant traits are complex during the physiological growth of the plant and have to be carefully examined in order to identify traits which are consistently dominant over a period of time. If identified, dominant plant traits could be better managed for attaining high crop yield under rainfed conditions. A multivariate assessment of 7 sunflower genotypes has been made in this study for identifying the most dominant plant traits which are consistent for the physiological growth under moisture stress conditions on alfisol.

MATERIALS AND METHODS

Experimental data

Six field experiments have been conducted with seven sunflower genotypes *viz.*, Guj-sun-1, MSFH-8, MSFH-17, KBSH-1, Jwala, Pac-36 and Morden during *kharif* 1994 to 1999 seasons with the objective of identifying the dominant plant traits which are consistent for plant growth over a period of time. The dates of sowing and harvest along with the rainfall received up to 30, 45 and 60 days after sowing during crop growth are given below.

Season	Date of sowing	Date of harvest	Rainfall (mm)		
			30 DAS	45 DAS	60 DAS
1994	6th July	19th October	72.2	107.0	69.2
1995	3rd July	25th October	18.3	18.6	124.0
1996	8th July	10th October	142.0	86.0	226.0
1997	4th July	14th October	88.1	6.7	69.2
1998	9th July	20th October	194.2	193.5	55.5
1999	5th July	21st October	185.5	22.6	21.3

Observations were recorded on 14 different plant traits *viz.*, leaf nitrogen (LN) (%), leaf area (LA) (cm^2), leaf weight (LW) (g), leaf number (NU), stem nitrogen (SN) (%), stem weight (SW) (g), root length (RL) (cm), root weight (RW) (g), stomatal conductance (SC) (cm sec^{-1}), photosynthesis (PS) (μmol $m^{-2}sec^{-1}$), plant height (PH) (cm), total biomass (TB) (g) 30, 45 and 60 days after sowing and flower head diameter (HD) (cm) and flower head weight (HW) (g) 45 and 60 days after sowing in each season.

Table 1: Means and variation coefficients of plant traits in sunflower on different days after sowing in 6 *kharif* seasons

Trait	30 DAS		45 DAS		60 DAS	
	Mean	CV (%)	Mean	CV (%)	Mean	CV (%)
LN	2.97	58.7	3.16	47.7	2.34	51.9
LA	464.49	38.8	1531.23	32.6	2023.23	35.2
LW	2.03	50.0	7.14	46.8	11.20	38.1
NU	13.68	16.6	21.23	6.70	24.68	12.8
SN	0.98	51.7	1.54	38.3	0.82	54.5
SW	1.18	53.7	6.11	52.1	14.04	46.6
SC	2.11	0.30	1.26	56.9	2.03	27.0
PS	23.48	27.4	26.31	14.0	23.95	18.8
RL	4.16	41.5	10.67	20.9	12.46	28.2
RW	0.35	36.4	1.75	15.0	2.73	60.5
TB	3.01	60.6	14.68	62.6	36.81	69.6
PH	19.67	28.0	74.82	59.3	97.46	19.8
HD	@	@	2.52	16.3	7.23	36.1
HW	@	@	0.79	28.6	7.42	64.0

@: Observations on HD and HW are not available on the 30^{th} day after sowing

DAS: Days after sowing, CV: Coefficient of variation (%),
LN: Leaf nitrogen (%), SW: Stem weight (g),
LA: Leaf area (cm^2), SC: Stomatal conductance (cm sec^{-1}), TB: Total biomass (g),
LW: Leaf weight (g), PS: Photosynthesis (μmol $m^{-2}sec^{-1}$), PH: Plant height (cm),
NU: Leaf number, RL: Root length (cm), HD: Flower head diameter (cm),
SN: Stem nitrogen (%), RW: Root weight (g), HW: Flower head weight (g)

The means and variation coefficients of the different plant traits 30, 45 and 60 days after sowing over 6 *kharif* seasons are given in Table 1. There was a wide variation in the data of different plant traits as observed 30, 45 and 60 days after sowing which as indicated by the means and standard deviations of the traits over the 6 seasons of study. High variation of more than 50% was found in LN, LW, SN, SW and TB 30 days after sowing, SW, SC, TB and PH 45 days after sowing and LN, SN, RW, TB and HW 60 days after sowing. Correlations between plant traits were estimated for assessing the depth of relation on different days after sowing in addition to identifying plant traits important for efficient sunflower growth on alfisols. In a study by Maruthi Sankar *et al.* (2001a), the authors have reduced the dimensionality of the problem from 8 plant traits to just two leading principal components which have extracted about 80% of variation in the data of original traits for sunflower growth on alfisol. The dominant plant traits could be identified based on the magnitudes of the loadings of the traits on the two leading principal components. However, a plant trait dominant on a given day after sowing may not be dominant on a subsequent day in the same season. Similarly, a trait dominant in a given season may not be dominant in a subsequent season. In view of this, it is important to identify dominant plant traits which are also consistent over a period of time since such traits, if identified, could be better managed for attaining desired plant growth and higher yield under moisture stress conditions. In this paper, the authors proposed a quadrangular plotting of mean and standard deviation of loadings of plant traits on the 1st two principal components for identifying the dominant and consistent traits on different days after sowing. The four quadrangles which would represent the behavior of different plant traits are as follows:

	1st principal component	2nd principal component
Q I	High mean (-0.1 to 0.3) and low standard deviation (0 to 0.3)	High mean (0.2 to 0.8) and low standard deviation (0 to 0.4)
Q II	High mean (-0.1 to 0.3) and high standard deviation (0.3 and above)	High mean (0.2 to 0.8) and high standard deviation (0.4 and above)
Q III	Low mean (-0.1 and below) and high standard deviation (0.3 and above)	Low mean (0.2 and below) and high standard deviation (0.4 and above)
Q IV	Low mean (-0.1 and below) and low standard deviation (0 to 0.3)	Low mean (0.2 and below) and low standard deviation (0 to 0.4)

The traits which fall into Q I are considered to be dominant (high mean) and consistent (low standard deviation) plant traits and they have a positive implication on plant growth as attained in different seasons. The traits which fall into Q II are considered to be dominant (high mean) and inconsistent (high standard deviation) over seasons and they have a positive implication on plant growth. The traits which fall into Q III are considered to be non-dominant (low mean) and also inconsistent (high standard deviation) over seasons and they have a negative implication on plant growth. The traits which fall into Q IV are considered to be non-dominant (low mean) but are consistent (low standard deviation) over seasons and they have a negative implication on plant growth. The dominant plant traits which are consistent over a period of time are identified based on a detailed principal component analysis of data generated from 6 sunflower field experiments in the following section and the results are discussed.

RESULTS AND DISCUSSION

The correlation analysis of the traits as observed 30, 45 and 60 days after sowing was carried out for the data of 7 sunflower genotypes over 6 *kharif* seasons. The results of correlation between the different plant traits are given in Table 2.

Table 2: Estimates of correlation between plant traits in sunflower on different days after sowing in 6 *kharif* seasons

Trait		30 DAS	45 DAS	60 DAS
LA	LN	0.254	0.324*	0.690**
	LW	0.838**	0.901**	0.894**
	NU	0.698**	0.571**	0.562**
	SN	-0.028	0.279	0.592**
	SW	0.773**	0.823**	0.695**
	SC	-0.160	-0.157	-0.041
	PS	-0.020	0.244	0.294
	RL	-0.494**	0.619**	0.409**
	RW	0.621**	0.821**	0.769**
	TB	0.753**	0.590**	0.864**
	PH	0.607**	0.613**	0.619**
	HD	@	0.342*	0.561**
	HW	@	0.328*	0.599**
LN	LW	0.162	0.573**	0.691**
	NU	-0.087	0.226	0.446**
	SN	0.272	0.540**	0.716**
	SW	0.274	0.342*	0.539**
	SC	-0.176	-0.187	-0.077
	PS	-0.016	0.106	0.133
	RL	@	0.605**	0.207
	RW	@	0.277	0.589**
	TB	0.543**	0.489**	0.549**
	PH	-0.015	0.194	0.269
	HD	@	0.054	0.511**
	HW	@	-0.087	0.439**
LW	NU	0.651**	0.767**	0.548**
	SN	0.054	0.542**	0.692**
	SW	0.886**	0.792**	0.818**
	SC	-0.294	-0.135	0.009
	PS	-0.488**	-0.019	0.039
	RL	-0.019	0.640**	0.239
	RW	0.887**	0.850**	0.783**
	TB	0.974**	0.952**	0.940**
	PH	0.460**	0.662**	0.628**
	HD	@	0.324*	0.489**
	HW	@	0.326*	0.564**
NU	SN	0.147	0.406**	0.486**
	SW	0.728**	0.666**	0.421**
	SC	-0.184	-0.126	-0.002
	PS	-0.166	-0.129	-0.003
SN	SW	0.041	0.373*	0.524**
	SC	0.367*	-0.016	-0.019
	PS	-0.189	-0.019	0.351*
	RL	@	0.221	0.235
	RW	@	0.529**	0.364*
	TB	-0.152	0.536**	0.464**
	PH	-0.053	0.420**	0.385*
	HD	@	0.680**	0.304*
	HW	@	0.414**	0.185
SW	SC	-0.409**	-0.157	0.037
	PS	0.534**	0.114	0.370*
	RL	0.024	0.672**	0.145
	RW	0.888**	0.803**	0.785**
	TB	0.961**	0.963**	0.956**
	PH	0.667**	0.746**	0.860**
	HD	@	0.415**	0.495**
	HW	@	0.361*	0.546**
SC	PS	0.343*	-0.359*	-0.013
	RL	0.001	-0.291	-0.325*
	RW	0.325*	0.313*	-0.320*
	TB	-0.483**	0.162	-0.320*
	PH	-0.386*	0.179	-0.238
	HD	@	0.011	-0.210
	HW	@	-0.079	-0.160
PS	RL	0.124	0.408**	-0.250
	RW	0.248	0.008	-0.378*
	TB	-0.125	-0.120	0.302
	PH	-0.092	0.036	-0.023
	HD	@	-0.119	0.573**
	HW	@	-0.095	-0.296
RL	RW	0.426**	0.471**	0.435**
	TB	0.022	0.485**	0.686**
	PH	-0.185	0.403**	0.180
	HD	@	0.210	0.059
	HW	@	0.078	0.043
RW	TB	0.982**	0.785**	0.884**
	PH	0.432**	0.654**	0.591**
	HD	@	0.410**	0.477**
	HW	@	0.380*	0.483**
TB	PH	0.527**	0.664**	0.803**

Table 2: Continued

Trait		30 DAS	45 DAS	60 DAS	Trait		30 DAS	45 DAS	60 DAS
	RL	-0.193	0.571**	0.245		HD	@	0.420**	0.618**
	RW	0.498**	0.582**	0.386*		HW	@	0.382*	0.667**
	TB	0.534**	0.764**	0.395**	PH	HD	@	0.452**	0.328*
	PH	0.742**	0.802**	0.651**		HW	@	0.343*	0.292
	HD	@	0.440**	0.393**	HD	HW	@	0.874**	0.915**
	HW	@	0.287	0.445**					

* and ** indicate significance at 5 and 1% level

@: Observations on HD and HW are not available on 30th day after sowing

DAS: Days after sowing, CV: Coefficient of variation (%),
LN: Leaf nitrogen (%), SW: Stem weight (g),
LA: Leaf area (cm^2), SC: Stomatal conductance ($cm\ sec^{-1}$), TB: Total biomass (g),
LW: Leaf weight (g), PS: Photosynthesis ($\mu mol\ m^{-2} sec^{-1}$), PH: Plant height (cm),
NU: Leaf number, RL: Root length (cm), HD: Flower head diameter (cm),
SN: Stem nitrogen (%), RW: Root weight (g), HW: Flower head weight (g)

The analysis indicated that LA had significant correlation with LW, NU, SW, RL, RW, TB, PH (30, 45 and 60 DAS), LN, HD, HW (45, 60 DAS) and SN (60 DAS), while it had no relation with SC and PS (30, 45 and 60). LN had significant relation with TB (30, 45 and 60), LW, SN, SW (45, 60), RL (45) and NU, RW, HD, HW (60), while it had no relation with SC, PS and PH. LW had significant relation with NU, SW, RW, TB, PH (30, 45 and 60), SN, HD, HW (45, 60), PS (30) and RL (45), while it had no relation with SC. NU had significant relation with SW, RW, TB, PH (30,45 and 60), SN, HD, HW (45, 60) and RL (45), while it had no relation with SC and PS. SN had significant relation with SW, RW, TB, PH, HD (45, 60), SC (30), HW (45) and PS (60), while it had no relation with RL. SW had significant relation with RW, TB, PH (30, 45 and 60), PS (30, 60), HD, HW (45, 60), SC (30) and RL (45). SC had significant relation with RW (30, 45 and 60), PS (30, 45), TB (30, 60), PH (30) and RL (60), while it had no relation with HD and HW. PS had significant relation with RL (45) and RW and HD (60), while it had no relation with TB, PH, HW. RL had significant relation with RW (30, 45 and 60), TB (45, 60) and PH (45), while it had no relation with HD and HW. RW had significant relation with TB, PH (30, 45 and 60), HD and HW (45, 60). TB had significant relation with PH (30, 45 and 60) and HD, HW (45, 60). PH had significant relation with HD (45, 60) and HW (45). HD had significant relation with HW (45, 60).

The distribution of loadings of traits on first two principal components 30, 45 and 60 days after sowing over the 6 *kharif* seasons is given in Table 3. The mean and standard deviation of loadings of each trait on the 1st principal component have indicated the dominance of SW, LW, NU, RW on the 30th day after sowing. Similarly LA and LW on the 45th day and LA, TB and LW on the 60th day after sowing were found to be dominant on the 1st principal component. RL on the 30th day, HD and HW on the 45th day and RL and PS on the 60th day after sowing were also found to be dominant since they had significantly higher loadings on the 2nd principal component.

Table 3: Distribution of loadings of traits on first two principal components in sunflower in 6 *kharif* seasons

Trait	30 DAS				45 DAS				60 DAS			
	First PC		Second PC		First PC		Second PC		First PC		Second PC	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
LA	-0.269	0.403	0.078	0.438	-0.439	0.093	-0.004	0.203	-0.422	0.067	-0.098	0.290
LW	-0.451	0.032	-0.049	0.161	-0.416	0.063	0.035	0.173	-0.401	0.049	0.106	0.143
LN	0.088	0.338	-0.159	0.600	-0.098	0.344	0.191	0.467	-0.077	0.459	0.331	0.181
NU	-0.407	0.091	0.124	0.240	-0.347	0.078	-0.135	0.325	-0.334	0.138	0.179	0.265
SW	-0.459	0.032	0.127	0.305	-0.387	0.041	-0.169	0.091	-0.393	0.081	-0.122	0.345
SN	-0.118	0.131	-0.088	0.730	-0.383	0.439	0.301	0.100	-0.062	0.425	0.287	0.331
RL	0.056	0.001	0.741	0.001	-0.274	0.078	-0.295	0.199	-0.077	0.262	-0.474	0.236
RW	-0.406	0.067	0.186	0.411	-0.353	0.071	-0.065	0.054	-0.315	0.008	-0.109	0.057
SC	0.205	0.066	0.095	0.349	0.119	0.156	0.311	0.326	0.029	0.043	-0.145	0.741
PS	0.293	0.093	0.293	0.110	-0.154	0.276	0.038	0.586	-0.209	0.329	-0.406	0.154
PH	-0.375	0.096	-0.163	0.622	-0.330	0.043	0.140	0.310	-0.348	0.111	0.267	0.505
TB	-0.156	0.504	-0.234	0.204	-0.150	0.431	0.095	0.303	-0.415	0.066	-0.148	0.275
HD	@	@	@	@	-0.225	0.043	0.571	0.147	-0.292	0.047	-0.319	0.327
HW	@	@	@	@	-0.012	0.269	0.568	0.141	-0.313	0.086	0.115	0.410

@: Observations on HD and HW are not available on 30th day after sowing

DAS: Days after sowing, CV: Coefficient of variation (%), LN: Leaf nitrogen (%), SW: Stem weight (g), LA: Leaf area (cm^2), SC: Stomatal conductance ($cm\ sec^{-1}$), TB: Total biomass (g), LW: Leaf weight (g), PS: Photosynthesis ($\mu mol\ m^{-2} sec^{-1}$), PH: Plant height (cm), NU: Leaf number, RL: Root length (cm), HD: Flower head diameter (cm), SN: Stem nitrogen (%), RW: Root weight (g), HW: Flower head weight (g)

The consistency of plant traits has been examined by a graphic plot of mean and standard deviation of loadings of each trait on the 1st principal component (Figure 1) and the 2nd principal component (Figure 2). Four groups of traits (Q I to Q IV) were found to exist based on the graphic plots *viz.*, traits with high mean and low standard deviation (Q I), high mean and high standard deviation (Q II), low mean and high standard deviation (Q III) and low mean and low standard deviation (Q IV) of loadings of traits. Based on the graphic plot, RL (30 and 60 DAS), SC (30, 45 and 60) and PS (30) were found to be consistent since they had a high means in their loadings with low standard deviation (Q I) on the 1st principal component. Similarly, LN (30, 45 and 60) and SN (60) had high mean and high standard deviation (Q II), while SN (45), LA (30) and PS (60) had low mean and high standard deviation (Q III). The remaining traits *viz.*, SN (30), TB (60), SW (30, 45 and 60), NU (30, 45 and 60), PH (30, 45 and 60), HW (45, 60), RL (45), HD (45, 60), RW (30, 45 and 60), LW (30, 45 and 60), LA (45, 60) and PS (45) had low mean and low standard deviation (Q IV) of loadings of traits on the 1st principal component.

Similarly, SN (45 and 60), SC (45), PS (30), LN (60), RL (30), HD (45) and HW (45) were also consistent since they had a high mean with low standard deviation (Q

I) in their loadings on the 2nd principal component. PH (60) was found to have high mean with high standard deviation (Q II). RW (30), LN (30, 45), HW (60), LA (30), PS (45), PH (30), SC (60) and SN (30) were found to have low mean with high standard deviation (Q III) in their loadings. The remaining traits *viz.*, PS (60), RL (45, 60), HD (60), TB (30, 45 and 60), NU (30, 45 and 60), SW (30, 45 and 60), LA (45, 60), LW (30, 45 and 60), RW (45, 60), PH (45) and SC (30) had low mean and low standard deviation (Q IV).

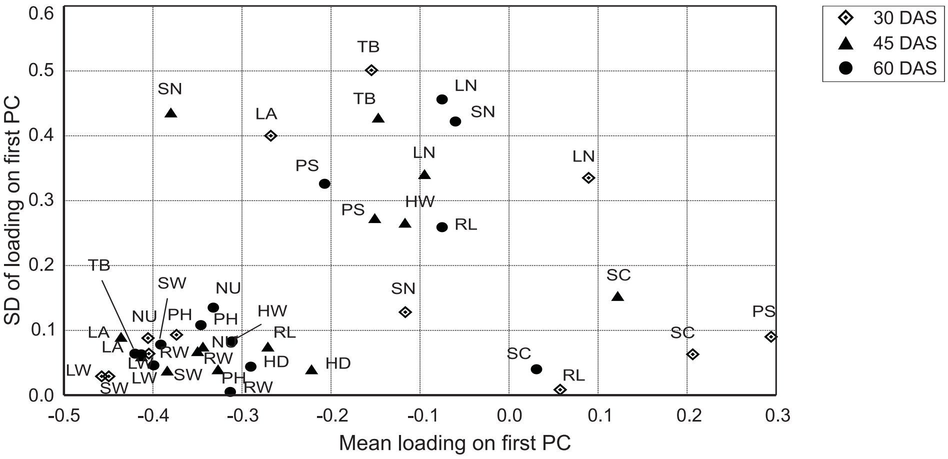

Figure 1: Consistency of plant traits in sunflower based on loadings on first principal component.

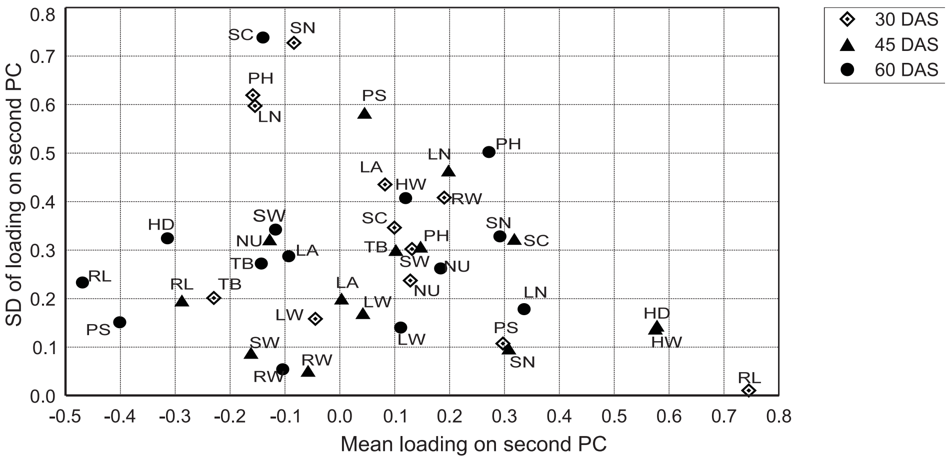

Figure 2: Consistency of plant traits in sunflower based on loadings on second principal component.

The study indicated the plant traits stomatal conductance, photosynthesis, root length, stem nitrogen, leaf nitrogen, flower head diameter and flower head weight as dominant and consistent traits for sunflower growth in different seasons.

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SELECCIÓN DE LAS CARACTERÍSTICAS CONSISTENTES DEL CRECIMIENTO DE GIRASOL, UTILIZANDO EL ANÁLISIS DE LAS COMPONENTES PRINCIPALES

RESUMEN

Se aplicó el análisis de los componentes principales, con el fin de evaluar la consistencia de 14 características de crecimiento de girasol. Se utilizaron los datos multivariacionales de 6 ensayos de campo, realizados durante la campana 'karif' desde 1994 hasta 1999, basadas en alfisol, sin aplicación de riego. En las investigaciones se utilizaron siete genotipos, Guj-sun-1, MSFH-8, MSFH-17, KBSH-1, Jwala, Pac-36 y Morden. Las observaciones, realizadas durante cada campana, abarcaban el contenido de nitrógeno en la hoja, la superficie de la hoja, el peso de la hoja, el número de hojas, contenido de nitrógeno en el tallo, el peso del tallo, la longitud de la raíz, el peso de la raíz, la conductibilidad de los estomas, la actividad fotosintética, la biomasa total a los 30, 45 y 60 días de siembra (DDS), diámetro del capítulo y el peso del capítulo a los 45 y 60 días de siembra. Las primeras dos componentes principales abarcaban alrededor de 80% de variación para las características investigadas en los días seguidos a la siembra. La consistencia entre las características fue evaluada por investigación de las correlaciones entre ellas y la distribución de la carga de las primeras dos componentes principales, 30, 45 y 60 días seguidos a la siembra.

Los resultados obtenidos han indicado que el peso del tallo y el peso del capítulo en el día 30, el número de capítulos, la superficie de la hoja y el peso de la hoja en el día 45, y la superficie de la hoja, el peso de la hoja y la biomasa total en el día 60, tenían una carga significativamente mayor en la primera componente principal. Semejante a ello, el peso de la raíz en el día 30, el diámetro del capítulo y el peso del capítulo en el día 45 y la longitud de la raíz y la actividad fotosintética a 60 días de siembra, tenían una carga significativamente mayor en la segunda componente principal. Sobre la base de la representación gráfica de la carga, se ha detectado que la longitud de la raíz (a 30 y a 60 días DDS), la conductibilidad de los estomas (a 30, 45 y 60 días DDS) y la actividad fotosintética (a 30 días DDS) eran consistentes, debido a que su carga de la primera componente principal tenía altos valores medios y baja desviación estándar. Semejante a ello, el contenido de nitrógeno en el tallo (a

45 y a 60 días DDS), la conductibilidad de estomas (a 45 días DDS), la actividad fotosintética (a 30 días DDS), el contenido de nitrógeno en la hoja (a 60 días DDS), la longitud de la raíz (a 30 días DDS), el diámetro del capítulo (a 45 días DDS) y el peso del capítulo (a 45 días DDS) eran muy consistentes, debido a que su carga de la segunda componente principal tenía altos valores medios y baja desviación estándar.

SÉLECTION DE CARACTÉRISTIQUES CONSTANTES DANS LA CROISSANCE DU TOURNESOL PAR L'ANALYSE DES COMPOSANTS PRINCIPAUX

RÉSUMÉ

L'analyse des composants principaux a été utilisée pour évaluer la constance de 14 caractéristiques de la croissance du tournesol. Les données multivariables des expériences menées dans six champs durant la saison de "kharif" des années 1994 à 1999 et basées sur un alfisol sans irrigation ont été utilisées. L'étude portait sur sept génotypes, Guj-sun-1, MSFH-8, MSFH-17, KBSH-1, Jwala, Pac-36 et Morden. Les observations ont été faites chaque saison et portaient sur le contenu d'azote dans la feuille, la superficie de la feuille, le poids de la feuille, le nombre de feuilles, le contenu d'azote dans la tige, le poids de la tige, la longueur de la racine, le poids de la racine, la conductibilité des stomates, la photosynthèse, la biomasse totale 30, 45 et 60 jours après les semailles (JAS) ainsi que le diamètre de la tête et le poids de la tête 45 et 60 jours après les semailles. Les deux premiers composants principaux comprenaient environ 80% de variance pour différentes caractéristiques, différents jours après les semailles. La constance a été évaluée par l'examen de la corrélation entre différentes caractéristiques et par celui de la distribution des charges des deux premiers composants principaux 30, 45 et 60 jours après les semailles.

Les résultats indiquent que le poids de la tige et le poids de la tête au 30e jour, la superficie de la feuille et le poids de la feuille au 45e jour ainsi que la superficie de la feuille, le poids de la feuille et la biomasse totale au 60e jour après les semailles avaient une charge significativement plus élevée sur le premier composant principal. De la même manière, la longueur de la racine au 30e jour, le diamètre de la tête et le poids de la tête au 45e jour ainsi que la longueur de la racine et la photosynthèse au 60e jour après les semailles avaient une charge significativement plus élevée sur le deuxième principal composant. Selon une représentation graphique des charges, la longueur de la racine (30e et 60e JAS), la conductibilité des stomates (30e, 45e et 60e JAP) et la photosynthèse (30e JAS) se sont montrés constants puisque leur charge sur le premier principal composant avait des valeurs moyennes élevées avec des déviations standard faibles. De la même manière, le contenu d'azote dans la tige (45e et 60e JAS), la conductibilité des stomates (45e JAS), la photosynthèse (30e JAS), le contenu d'azote dans la feuille (60e JAS), la longueur de la racine (30e JAS), le diamètre de la tête (45e JAS) et le poids de la tête (45e JAS) étaient aussi constants puisque leur charge sur le deuxième composant principal avait des valeurs moyennes élevées avec des déviations standard faibles.