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DIFFERENTIAL SUSCEPTIBILITY OF SOME SUNFLOWER GENOTYPES TO PHOSPHORUS DEFICIENCY IN A BLACK SOIL

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SUMMARY

In a pot culture study, using phosphorus deficient black soil, four promising sunflower genotypes (KBSH-1, DSH-1, Sungene-85 and PAC-36) were tested for their differential susceptibility to the deficiency of this nutrient. Phosphorus deficiency symptoms were noticed in the hybrids KBSH-1 and DSH-1 while PAC-36 was almost free from these. The maximum grain yield response to phosphorus was recorded in KBSH-1 and the minimum in PAC-36. Dry matter yield followed a similar trend. On the basis of yield response and P uptake, the susceptibility of the genotypes was rated in the following order: PAC-36 < Sungene-85 < DSH-1 < KBSH-1.

Key words: black soil, *Helianthus annuus* L., phosphorus

INTRODUCTION

The differential behaviour regarding phosphorus response among crop genotypes has been related to their capacity to exploit native phosphorus and/or to translocate it to the site of physiological activity. Some genotypes of sunflower have been reported (Farah *et al.,* 1981; Nayak and Ghose, 1990; Hiremath *et al.,* 1992; Naphade and Naphade, 1992; Lal *et al.,* 1998) to differ in their yielding capacity and respond to change in P availability in the soil. In recent years, several high yielding varieties of sunflower grown in black soils of the country were found deficient in phosphorus and it was considered to be of interest to study the performance of promising sunflower genotypes in phosphorus deficient soils and also their performance to the application of phosphorus. Such information are obviously important to decide about phosphorus application to these genotypes.

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MATERIALS AND METHODS

A pot culture experiment was conducted during *kharif* 1999 using black soil deficient in available phosphorus at Directorate of Oilseeds Research, Rajendranagar, Hyderabad. The important characteristics of the experimental soil are given in Table 1.

Table 1: Characteristics of soil

Property	Value
pH	7.7
Organic carbon (%)	0.6
Available N [kg ha^{-1}]	156.8
Available P [kg ha^{-1}]	5.0
Available K [kg ha^{-1}]	341.0
Ca+Mg [c mol (p^{+}) kg^{-1}soil]	45.5

Soil analysis was carried out as per standard procedures given by Jackson (1967). The treatments consisted of four genotypes (KBSH-1, DSH-1, Sungene-85 and PAC-36) and three levels of phosphorus, 0, 45 and 90 kg P_2O_5 ha^{-1} (Table 2) applied as potassium dihydrogen orthophosphate. Earthen pots of 5 kg were lined with polyehtelene bags and filled with 4 kg soil after processing. The experiment was conducted in a completely randomized block design with three replicates. Basal doses of 37.5 kg N and 30 kg K_2O ha^{-1} were applied as urea and muriate of potash, respectively, and the remaining dose of urea was applied as split doses of 18.75 kg each. Ten seeds of sunflower were planted in each pot and they were thinned to maintain three plants per pot after germination. The crop was grown till harvest. The plants were sampled at flowering and harvest stages by cutting at the soil surface. Shoot and seed yields were recorded. The plant samples were washed with 0.1 M HCl followed by distilled water, dried at 65°C and pulverized. The plant material was digested in tri-acid mixture and total P was estimated by following standard procedure (Jackson, 1967).

Table 2: Seed yield (g/plant) as affected by different levels of P and genotype

Genotype	P levels (P_2O_5)			Mean seed yield (g/plant)	Response (%)
	0	45	90		
Sungene-85	0.62	1.04	1.72	1.12	109
DSH-1	0.47	0.94	1.75	1.05	180
KBSH-1	0.45	1.94	3.08	1.82	457
PAC-36	1.91	2.23	3.70	2.61	55
Mean	0.86	1.54	2.56		202
C.D. ($P<0.01$)	P level: 0.44 genotype: 0.51 P × genotype				

RESULTS AND DISCUSSION

In pots receiving no phosphorus, all the genotypes except PAC-36 exhibited P deficiency symptoms in varying degrees of intensity. The symptoms were characterized by mild chlorosis, water soaked areas, mimic biotic infection and necrosis which starts at the edges and spreads to the entire lamina untill leaves get dry up. These symptoms were visible mainly in the middle leaves and the affected plants remained stunted. Application of phosphorus markedly increased the seed yield in all the genotypes but the magnitude of response in individual genotypes varied with P level (Table 2). The genotypes KBSH-1 and DSH-1 recorded maximum seed yield responses at 90 kg P_2O_5 ha^{-1} dose; KBSH-1 was highly responsive (457%) and PAC-36 the least responsive (55%) to P application. The genotypes which showed increased response were ranked as more susceptible to P stress. On the basis of per cent seed yield response (numbers shown in brackets), the relative susceptibility of sunflower genotypes to P stress can be rated as follows:

KBSH-1	>	DSH-1	>	Sungene-85	>	PAC-36
(457)		(186)		(109)		(55)

Similarly, increased yields of sunflower in response to the P application of 60 kg P_2O_5 ha^{-1} were reported by Naphade and Naphade (1992) and Nayak and Ghose (1992).

P uptake

The application of phosphorus to the soil significantly increased its total uptake in all the genotypes (Table 3) and its magnitude differed appreciably. DSH-1 and KBSH-1 in comparison with the other genotypes removed the least amount (1.45 to 1.91 mg/plant) under P stress conditions and exhibited high susceptibility to its deficiency.

Table 3: P uptake (mg/plant) influenced by different levels of P and genotype

Genotype	P levels (kg P_2O_5 ha^{-1})			Mean seed P uptake (mg/plant)	Response (%)
	0	45	90		
Sungene-85	1.99	4.20	12.45	6.21	318
DSH-1	1.45	6.10	15.09	7.55	630
KBSH-1	1.91	7.90	15.88	11.37	522
PAC-36	4.41	9.25	20.45	8.42	236
Mean	2.44	6.86	15.97		426.5
C. D. ($P<0.01$)	P level: 0.44 genotype: 0.51 P × genotype				

The genotype PAC-36, on the other hand, recorded comparatively much greater uptake of P (4.41 mg/plant) and indicated tolerance to its deficiency. These results clearly showed that there existed differences among the genotypes in the ability to extract the available the available P under P stress conditions in the amount needed to meet the crop requirement. The findings are in agreement with those reported by

Hiremath *et al.* (1992). In general, per cent increase in total uptake at both P levels over control was found to be superior in KBSH-1 compared with the other genotypes.

CONCLUSIONS

It is evident from the above, that DSH-1 and KBSH-1 are more susceptible to phosphorus application than PAC-36. Differential P response in the sunflower genotypes may be attributed to genetic variation in root length and other related plant characteristics. Root length of the genotypes susceptible to P deficiency was found to be reduced.

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DIFERENCIA DE SENSIBILIDAD ENTRE LOS GENOTIPOS DE GIRASOL SEGÚN CARENCIA DE FÓSFORO EN EL SUELO TIPO HUMÍFERO

RESUMEN

En el ensayo en receptáculos llenados de humífero, con bajo contenido de fósforo, se ha investigado la sensibilidad de cuatro genotipos de girasol (KBSH-

1, DSH-1, Sungene-85 y PAC-36) a carencia de este abono en el suelo. Los síntomas de carencia de fósforo, se han notado en los híbridos KBSH-1 y DSH-1, mientras que el híbrido PAC-36 casi en absoluto mostró estos síntomas. KBSH-1 con el rendimiento demostró la mayor reacción a carencia de fósforo, mientras que PAC-36 demostró la menor. La reacción del rendimiento de la materia seca, fue semejante. A base de la reacción del rendimiento y adopción de fósforo, se hizo el siguiente ranking de los híbridos investigados, en cuanto a la sensibilidad a carencia de fósforo: PAC-36 < Sungene-85 < DSH-1 < KBSH-1.

DIFFÉRENCES ENTRE CERTAINS GÉNOTYPES DE TOURNESOL SELON LEUR SENSIBILITÉ AU MANQUE DE PHOSPHORE DANS LE SOL DE TYPE TCHERNOZIOM

RÉSUMÉ

Quatre génotypes de tournesol (KBSH-1, DSH-1, Sungene-85 et PAC-36) ont été étudiés au cours d'une expérience utilisant des pots contenant un tchernoziom pauvre en phosphore pour évaluer leur sensibilité à cette carence nutritive. Des symptômes de carence en phosphore ont été observés chez les hybrides KBSH-1 et DHS-1 alors que ces symptômes étaient presque totalement absents dans l'hybride PAC-36. Le rendement a montré que l'hybride KBSH-1 avait la réaction la plus importante devant le manque de phosphore et l'hybride PAC-36 la moins importante. La réaction quant au rendement de matière sèche a été similaire. Le rendement et l'absorption de phosphore ont servi de base pour ranger les hybrides examinés du point de vue de leur sensibilité au manque de phosphore de la manière suivante: PAC-36 < Sungene-85 < DSH-1 < KBSH-1.