EVALUATION OF COMBINING ABILITY FOR CHEMICAL COMPONENTS OF FORAGE SORGHUM

S. P. Shaug[1] and K. D. Lo[2]

[1]Department of Forage Crops and [2]Department of Technical Service, Taiwan Livestock Research Institute, Hsinhua, Tainan, Taiwan, Republic of China

ABSTRACT

The objective of this study was to investigate the genetic behaviors of crude protein (CP), potassium (K), calcium (Ca), magnesium (Mg) and hydrocyanic acid (HCN) by using 28 forage sorghum lines (including one set of half diallel cross and seven parents) as experimental materials. The results showed that the differences of all chemical components except Mg were significant among parents at heading and maturity. The mean squares of general(GCA) and specific (SCA) combining abilities of K and HCN at heading and maturity were all significant. Their additive variances were higher than their dominant variances at heading, however, similar at maturity. The SCA of CP was highly significant at heading and maturity,but GCA not. The Ca component was controlled by additive and dominant genes at heading, but only dominant genes at maturity. From above, it might be suggested that the concentrations of K, Ca and HCN could be improved by recurrent selection breeding in forage sorghum.

KEYWORDS

Forage sorghum, combining ability, chemical component

INTRODUCTION

Forage sorghum (*Sorghum* spp.) with drought tolerance and strong ability of regrowth is grown for greenchop (at heading) and silage (at maturity) in Taiwan. The chemical components such as CP, K, Ca and Mg in the whole plant can supply nutrients for livestock, but HCN will poison livestock when it exceeds 200 ppm. The concentrations of the above will also affect the quality of the ration. Therefore, it is important to understand the genetic behaviors of these to select elite lines of forage sorghum.

Grain sorghum (*S. bicolor*), sweet sorghum (*S. dochna*) and sudangrass (*S. sudanense*) which are easily fertilised and well fruited by each other (Endrizzi, 1957) were used as breeding materials in this experiment. The parental materials of the F1 hybrids were picked up randomly from sorghum germplasms conserved in Taiwan Livestock Reseach Institute (TLRI) to explore the genetic behaviors of above chemical components in the forage sorghum population. The variances of GCA and SCA and the genetic component of additive and dominance were evaluated (Hwu,1993) for investigating the variation of these omponents in forage sorghum.

MATERIALS AND METHODS

The experimental material was 28 forage sorghum lines (including one set of F1's and seven parents) from a 7x7 cross-classified design which were grown by a randomized complete block design with three replications at TLRI as a spring crop. All parental lines picked up from sorghum germplasm randomly were 59A, 54A, UI9A, 2R, Tifton, Tx7000 and 60A. Except for UI9A (sweet sorghum) and Tifton (sudangrass),the others were grain sorghum. Each plot consisted of three rows spaced 60 cm with a 20 cm spacing within row.The row length was three meters.The second leaves of three plants in the middle row were sampled from the plant top,dried and ground for assaying CP, K, Ca, Mg and HCN at heading and maturity stages, respectively.

These data were computed as follows: 1.The variances of GCA and SCA were analyzed by Griffing type ¢º random model (Griffing,1956). 2.The genetic components of additive and dominance were also estimated by the program developed by Wricke and Weber (1986).

RESULTS AND DISCUSSIONS

Mean squares (MS) of CP, K, Ca, and HCN were significantly different among seven parents of forage sorghum at heading and maturity stages, respectively (Table 1). Thus indicating that the concentrations of these chemical components were different among different genotypes. The MS of Mg among parents was not significant. So its heterosis and combining ability didn't make a difference. The MS of heterosis in CP at heading and K and HCN at maturity were highly significant. It showed that growing hybrid F1 would result in hybrid vigor in these components. The MS of general (GCA) and specific (SCA) combining abilities in K and HCN were significantly different and GCA were greater than SCA at heading and maturity stages. However, their genetic components of additive were higher than those of dominance at heading stage,but those were similar at maturity (Table 2). The results revealed that K and HCN are inheritable and can increase the genetic gain by recurrent selection in forage sorghum. The GCA in CP was not significant at heading, but was significant at maturity. It showed that the selection in forage sorghum lines with high CP should be postponed to later generations. The GCA and SCA in Ca were significant at heading, but only the SCA was significant at maturity. It showed that Ca was controlled by genes with additive and non-additive effects at heading, but only non-additive genes at maturity. From the above-mentioned, it might be suggested that the concentrations of K, Ca and HCN could be improved by recurrent selection. In addition,the growing of hybrid F1 will increase the level of CP at heading, K and HCN at maturity.

REFERENCES

Endrizz, I. E. 1957. Cytological studies of some species and hybrids in the Eu- Sorghum. Bot. Gaz. **119**:1 - 10.

Goodrich, R. D. and J. C. Meiske. 1985. Corn and sorghum silage. P. 527-536. In "Forage". Maurice, E. H., Robert, F. B. and Metcalfe, D. S. ed. 643 p. Iowa State University Press.

Gourley, A L. M. and J. W. Lusk. 1977. Sorghum silage quality as affected by soluble carbohydrate, tannins and other factors. Proc. Annu. Corn and Sorghum Res. Conf. **32**:157-170.

Griffing, A B. 1956. Concept of general and specific combining ability in relation to diallel crossing systems. Aust. J. Biol. Sci. **9**:463-493.

Hwu, K. K. 1993. Diallel cross analysis based on SAS/IML integrated environment. Chinese Agron. J. **3**:81-90.

Matzinger, D. F. and O. Kempthorne. 1956. The modified diallel table with partial inbreeding and interactions with the environment. Genetics **41**:822-823.

Pedersen, J. F., H. J. Gorz, F. A. Haskins and W. M. Ross. 1982. Variability for quality and agronomic traits in forage sorghum hybrids. Crop Sci. **22**:853-856.

Table 1
Analysis of variance of seven sorghum inbreds and their half diallel hybrids evaluated for chemical components at heading and maturity.

SOV	DF	Mean square at heading				
		CP	K	Ca	Mg	HCN
Parents	6	1.34**	0.02**	0.003*	0.0005**	277.1**
Heterosis	1	4.04**	0.002NS	0.0002NS	0.0003NS	9.6NS
GCA	6	5.25NS	0.02*	0.006*	0.0002	998.1**
SCA	14	1.95**	0.007**	0.001*	0.00009NS	238.5**
Error	54	0.17	0.003	0.0004	0.0001NS	5.2
SOV	Mean square at maturity					
		CP	K	Ca	Mg	HCN
Parents		1.10**	0.007**	0.009**	0.0003NS	118.3**
Heterosis		0.08NS	0.012**	0.0002NS	0.0002NS	243.4**
GCA		0.67NS	0.009*	0.004NS	0.001NS	255.9*
SCA		0.58**	0.003**	0.007**	0.0004	78.1**
Error		0.13	0.006	0.0006	0.0002	3.9

* and **:significant at 1% and 5% levels, respectively.

Table 2
Genetic estimates by additive and dominance variances of chemical components based on 7x7 half diallel cross of forage sorghum at heading and maturity.

Chemical components	Genetic component	
	Additive	Dominance
Heading		
CP	0	1.78
K	0.006	0.004
Ca	0.002	0.001
Mg	0	0
HCN	303.8	233.3
Maturity		
CP	0	0.45
K	0.002	0.002
Ca	0	0.006
Mg	0	0.0002
HCN	71.1	74.3