Plant Archives Vol. 18, Special Issue (ICAAAS-2018), 2018 pp. 15-18 ***ISSN 0972-5210***

ASSESSMENT OF COEFFICIENT OF VARIATION, CORRELATIONS BETWEEN YIELD AND YIELD ATTRIBUTES IN SUGAR BEET (*BETA VULGARIS* L.)

Drishti Singh, A. K. Mall*, Varucha Misra, Mukesh Kumar and A. D. Pathak

ICAR- Indian Institute of Sugarcane Research, Lucknow - 226 002 (Uttar Pradesh), India.

Abstract

An experimental study was conducted to evaluate the genetic variation and relationship between yield and its components in sugar beet. The existence of high PCV and GCV estimates for the morpho-biochemical traits indicated greater possibility of their improvement through selection in respective environments. High estimates of heritability and genetic advance were recorded for SRW and RY. In case of biochemical traits, most of the characters exhibited significant phenotypic or high order genotypic correlations in positive direction. In contrast, Brix and SC recorded strong negative association at both levels with high order positive genotypic correlations with yield contributing traits. In over all consideration, SRW, RL, RD and SC emerged as most important direct yield components owing to their high order positive direct effects at phenotypic as well as genotypic level.

Key words : Sugarbeet, GCV, PCV, correlation, sucrose, brix

Introduction

Sugar beet has been recognized as one of the most important plant species in that no other crop can equate its efficiency for converting solar energy to high-energy food. Sugar beet is a plant whose root contains a high concentration of sucrose and which is grown commercially for sugar production. Sugar beet (*Beta vulgaris* L.) is grown worldwide and produces one-third of the world's sugar supply (Draycott, 2006). Being a short period crop, it will make expensefluently in farmer's field without a competition of other sugar crops specially sugarcane. The productivity of sugar beet is 60t ha^{-1} (Islam *et al*., 2012). The plant consists of the root and a rosette of leaves. Sugar is formed by photosynthesis in the leaves and is then stored in the root. The root of the beet contains 75 water, about 20 sugars and 5 per cent pulp. The exact sugar content can vary between 12 and 21 per cent sugar, depending on the cultivar and growing conditions. Sugar beets grow exclusively in the temperate zone, in contrast to sugarcane, which grows exclusively in the tropical and subtropical zones. This crop constitutes 30 per cent of total world production and distributed in 45 countries. Now tropical Sugarbeet hybrids are acquire momentum in tropical and sub tropical countries including Tamil Nadu as a promising energy crop and alternative raw materials for the production of ethanol. Apart from sugar production, the value added products like ethanol can also be extracted from Sugarbeet. Sugarbeet crop is grown in 5 to 6 months depending on climatic conditions prevailing during crop growth period. Sugar beet provides an important alternative sugar source to cane.

Therefore, genetic variability is the basic requirement for making progress in crop breeding (Appalaswamy and Reddy, 2004). Therefore, genetic variability is the basic requirement for making progress in crop breeding. The objective of this study, using gamma rays on sugar beet was to create genetic variability to which improve the quantitative traits.

Materials and Methods

The study was conducted at Indian Institute Sugarcane Research, Lucknow. Planting of sugarbeet was sown on 15^{th} to 20^{th} October, 2016. The help of precision of row crop planters performed planting of sugarbeet. Plate and

****Author for correspondece :*** E-mail: ashutosh.mall@icar.gov.in

cell wheel planters or newer vacuum or air planters all work well. Sugarbeet was planted to thin to a final stand or space planted to a desired final plant population. Seeding rates vary from 1 to 2 lbs of seed/acre. The seeds used for planting were multi-germ varieties.

Fertilizer application : In general following are the main recommendations for fertilizer applications:

Nitrogen : 120-160 kg ha^{-1} to be applied in three equal dosages *viz*., Per sowing; one month after planting/ after thinning and two months after planting.

Potash : 80kg ha^{-1}

Phosphorous : Sowing application of fertilizer should be done after pre-irrigation and prior to final seedbed preparation.

Thinning : After 30 days from germination, thinning is necessary to maintain plant population's 20 cm. apart. A plant population of 50, 000 to 60, 000 ha^{-1} is considered to be optimum for good yield of high quality.

Irrigation : In all 6-8 irrigation are required for good yield of high yield quality beet. Beet should never be allowed to suffer from excess of storage of water at any time, especially during early stage. Do not irrigate at least 15-20 days before harvesting otherwise sucrose percentage will come down.

Weeding : Normally two-hand weeding would be sufficient to keep the crop weed free. Subsequently beet grows fast and takes care of the weeds.

Harvesting : Normally after 5-6 months when center of the leaves become yellowish compared to the green dark border, harvesting schedule should be decided in consultation with the factory so that the beets are subjected to minimum storage.

Plant materials : Thirteen hybrid varieties of Sugarbeet were chosen for the study to evaluate the genetic variation on quantitative characters in coefficient of variation. The seeds were collected from ICAR-Indian Institute of Sugarcane Research, Lucknow (UP).

Observation recorded : Single Leaf Weight (SLW), Single Root Weight (SRW), Root Diameter (RD), Root Length (RL), Brix (%), Sucrose Content (%), Purity, Root Yield (t ha^{-1}) were measured as per Misra *et al*. (2017).

Statistical analyses : The experimental data were compiled by taking mean values over randomly selected plants in each plot for all the three replications and subjected to the following statistical analysis:

Analysis of variance for design of experiment : The analysis of variance for the design of the experiment was carried out following Panse and Sukhatme (1985). The significance of differences among treatment means was tested by 'F' test.

Estimation of coefficients of variation and heritability : The phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) and heritability were computed following Burton and de Vane (1953).

Estimation of genetic advance : Genetic advance (Ga) was estimated by the method suggested by Johnson *et al*. (1955).

Estimation of correlation coefficients : The simple correlations (x) between different characters at phenotypic (p), genotypic (g) and environmental (e) levels were worked out as suggested by Searle (1961).

Results and Discussion

Heritability and genetic advance

Heritability is the proportion of genetic variance in phenotypic variance, expressed as a percentage. In the present study, heritability was high (above 70%) for all studied characters except SLW (34.6). The highest estimate of heritability was observed for root yield (94.3%), followed by SRW (94.0%). High heritability indicated that the environment less influenced the characters. Since high heritability does not always indicate a high genetic gain, heritability with genetic advance considered together should be used in predicting the ultimate effect of selecting superior varieties (Sreelathakumary and Rajamony, 2004 and Unche *et al*., 2008). Genetic advance was the highest for SRW and RY (41.54%) and coupled with high heritability. Ganapati *et al*. (2015) observed high heritability along with high genetic advance for the days to germination, germination, brix and yield except root length in sugarbeet. The present study indicated that SRW and RY showing high heritability and high genetic advance is important character to be considered for selection and improvement of winter malting barley. Furthermore, Ganapati *et al*. (2015) stated that Genetic advance (GA) is importance to predicting the expected genetic gain from one cycle of selection. Estimates of GA values for all characters studied are displayed in table 1. Estimates of genetic advance for RY was 41.54 g, indicating that whenever we select the best, 5 per cent high yielding genotypes as parents, mean RY of the offspring could be improved a large of 72.6 Kg.

Genotypic and phenotypic coefficient of variation

PCV and GCV values generally more than 20 per cent are regarded as high whereas value less than 10 per cent are considered to be low and values between 10-20

Table 1 : Mean, range, variability and heritability of eight characters in Sugar beet.

Characters	Mean±SEm	Range	Coefficient of Variation		Heritability	Genetic advancein per cent of mean
			GCV	PCV		
Single Leaf Weight	0.574±0.13	0.42-0.67	20.81	34.50	34.6	24.62
Single Root Weight	0.73±0.02	0.44-0.96	20.77	21.39	94.0	41.54
Root Length	29.39±0.83	25.27-33.27	9.86	10.99	80.4	18.21
Root Diameter	26.58±0.84	23.45-30.22	8.94	10.47	72.9	15.72
Brix (%)	16.50±0.35	14.07-18.67	6.88	7.78	78.4	12.56
Sucrose content (%)	13.43±0.38	11.25-17.43	11.47	12.45	84.9	21.76
Purity	74.31±1.33	69.80-78.45	3.32	4.53	53.5	4.99
Root yield (t ha^{-1})	72.60±2.14	44.33-95.67	20.77	21.39	94.3	41.54

Table 2 : Estimates of correlation coefficients in Sugarbeet genotypes.

Characters	Correlation	SLW	SRW	RL	RD	Brix (%)	SC (%)	Purity	RY (t ha^{-1})
Single leaf weight	r_g	**-0.013**	0.00	-0.063	-0.056	0.008	-0.013	0.031	0.002
	r_p	**0.039**	0.037	0.111	0.078	0.059	-0.040	0.303	0.037
Single root weight	r_g		**0.023**	0.594	0.531	-0.026	0.477	0.151	1.000
	r_p		**0.024**	0.547	0.475	-0.025	0.406	0.132	1.000
Root length	r_g			**8.39**	0.969	0.015	0.341	-0.393	0.594
	r_p			**10.43**	0.921	0.017	0.277	-0.198	0.547
Root diameter	r_g				**5.639**	0.137	0.0206	-0.441	0.531
	r_p				**7.733**	0.106	0.183	-0.141	0.476
Brix (%)	r_g					**1.291**	-0.038	0.425	-0.025
	r_p					**1.648**	-0.005	0.257	-0.026
Sucrose content (%)	r_g						**2.371**	0.004	0.476
	r_p						**2.794**	0.059	0.406
Purity	r_g							**6.073**	0.151
	r_p							**11.346**	0.132
Root yield (t ha^{-1})	r_g								**227.31**
	r_p								**241.025**

per cent to be medium quality parameters. The trait single leaf weight exhibit the highest genotypic and phenotypic variance i.e20.81 and 34.5 respectively and followed by the single root weight and root yield that have genotypic variance 20.77 and phenotypic variance 21.39. Lowest genotypic and phenotypic variance was recorded for the traits of brix (%), root diameter and root length i.e. 6.88 and 7.78 for brix; 8.94 and 10.47 for root diameter and 9.86 and 10.99 for the root length, respectively. The coefficient of phenotypic and genotypic variance was also calculated for all the traits under study. The genotypic coefficient of variance was ranged from 6.88% (Brix) to 20.81 (Single leaf weight). Similar trend was found for PCV also (Ganapati *et al*., 2015). In the present study, there was a close correspondence between genotypic and phenotypic coefficient of variation for all the recorded traits except SLW it showed that these characters less influenced by the environment.

Correlation coefficient

In the present study, none of the physio-biochemical characters exhibited strong positive association at genotypic and phenotypic level in control condition. Genotypic and phenotypic correlations among eight morpho-biochemical and yield traits in sugarbeet were computed (table 2). Slightly higher genotypic correlations than phenotypic ones indicated that strong inherent association between characters studied, its expression was lessened due to the influence of environment. The root yield was positively correlated with all characters under study except Brix (%) indicating the importance of these traits in selection for yield. From results of correlation studies provides a measure of association between the characters and reveals the character that might be useful as an index for selection.

The direct effect of SRW on Brix (%) was negative (r_g=-0.026 & r_p=-0.025) whereas SRW has positive indirect effects through rest of the characters of study. The phenotypic correlation between SLW and RY was positive (0.037). The direct effect of purity on root length was negative (r_g=-0.393 & r_p=-0.198) whereas purity has positive indirect effects through all characters except root diameter. Similar results were found by Ojo *et al*. (2006) and Malik *et al*. (2005). The genotypic correlation between root yield and other characters were positive except Brix (-0.025%). The direct effect of SLW on SC was negative (r_g=-0.013 & r_p=-0.040) whereas Brix (%) has also negative direct effects on SC. The genotypic correlation between SRW and RY was positive. These observations are in conformity with the finding of Yousuf and Saleem (2001). The existence of positive association or non-significant association among majority of biochemical traits represents a favorable situation for selection as compared to the situation where many strong negative correlations are observed between the traits along with strong positive associations.

Conclusion

Correlation exhibit high effect of single leaf weight, root diameter, root length and single root weight at harvest on root yield in crops. This study revealed that characters with higher GCV, PCV heritability coupled with genetic advance and positive association with root yield and heaving high direct and indirect effects are advocated as selection criteria while selection to be made for higher sugar and sugar yield assessment of genetic variability.

References

Appalaswamy, A. and G. L. K. Reddy (2004). Genetic divergence and heterosis studies of mungbean [*Vigna radiata* (L.) Wilczek]. *Legume Res*., **21** : 115- 118.

Burton, G. M. and E. H. de Vane (1953). Estimating heritability in tall fescue (*Festuca arundinacea*) from replicated clonal material. *Agron. J*., **45** : 471-481.

Draycott, A. P. (2006). Introduction In: Draycott A P, ed. Sugar Beet. Oxford, UK: Blackwell Publishing Ltd, 1–8.

Islam, M. S., S. Ahmad, M. N. Uddin and M. A. Sattar (2012). Evaluation of Tropical Sugar beet (*Beta vulgaris* L). Genotypes under Bangladesh Condition. *Bangladesh J. Agril. Res*., **37** : 721-728.

Johnson, H. W., H. F. Robinson and R. E. Comstock (1955). Estimation of genetic and environmental variability in soybean. *Agron J*., **47** : 314-318.

Malik, H. N., S. I. Malik, M. Hussain, S. U. R. Chughtai and H. I. Javed (2005). Genetic Correlation among Various Quantitative Characters in Maize (*Zea mays* L.) hybrids. *J. Agric. Social Sci*., **3** : 262–265.

Misra, V., U. Sah, A. K. Mall, Ram Kishor and A. D. Pathak (2017). Identification and evaluation of different sugarbeet germplasm for high yield and sucrose content under Indian Agro-climatic conditions. *Bulletin of Environment, Pharmacology and Life Sciences*, **6(2)** : 292-295.

Ojo, D. K.,O. A. Omikunle, O.A. Oduwaye, M. O. Ajala and S. A. Mao (2006). Heritability, Character Correlation and Path Coefficient Analysis among Six Inbred-Lines of Maize (*Zea mays* L.). *World J. Agric. Sci*., **2** : 352-358.

Panse, V. G. and P. V. Sukhatme (1985). *Statistical Methods for Agricultural Workers*. Indian Council of Agricultural Research Publication, 87-89.

Ganapati, R. K., R. Rani, K. M. R. Karim, R. K. Roy, M. M. Rahman and M. R. Alam (2015). Variability, Heritability and Genetic Advance of Quantitative Traits in Sugar Beet (*Beta vulgaris* L.) by Effect of Mutation. *Int. J. Plant Biol. Res*., **3(4)** : 1043-1046.

Searle, S. R. (1961). Phenotypic, genotypic and environmental correlations. *Biometrics*, **17** : 474-480.

Sreelathakumary, I. and L. Rajamony (2004). Variability, heritability and genetic advance in chilli (*Capsicum annum* L.). *J. Trop. Agric*., **2** : 35-37.

Unche, P. B., M. B. Misal, S. B. Borgaonkar, G. V. Godhawale, B. D. Chavan and D. R. Sawant (2008). Genetic variability studies in sweet sorghum (*Sorghum bicolor* L.Moench). *Intern. J. Plant Sci*., **1** : 16-18.

Yousuf, M. and M. Saleem (2001). Correlation Analysis of S1 Families of Maize for Grain Yield and its Components. *Inter. J. Agric. Biol*., **4** : 387–388.