**Studies on stability parameter and sustainability index for selecting stable genotypes of sugarcane (*Saccharum officinarum* L.)**

**N.R. Koli, R.K. Bagri and B.L.Kumhar**

Agricultural research station, Ummedganj Farm, Kota, Rajasthan.324001

(*Agriculture University, Kota*),

Email: [nanag70@yahoo.co.in](mailto:nanag70@yahoo.co.in)

**Abstract:-**

A comparative studies on stability parameters and sustainability index for selecting stable genotypes of sugarcane was carried out according to Eberhart and Russell Model, with sustainability index model. Stability analysis was carried out on seven sugarcane genotypes for cane yield (q/ha), CCS (q/ha), CCS % juice, Brix (%), Sucrose (%) and single cane weight (kg) at maturity stage (300 Days) on three year data viz; 2010-11,2011-12 and 2012-13. Based on the linear component (bi), non-linear response (s2di) and high mean performance (X) the genotype CoH-7261 and Co-6032 were found stable for cane yield (q/ha) and CCS q/ha yield, whereas genotype Co-7025 was found stable for CCS % juice, Brix %, Sucrose % and Single cane weight (Kg.) and on the basis of high sustainability index more than 90 % which indicated that these traits are least influenced by the environmental factors.

**Key words: -** Stability parameter, sustainability index, cane yield and *Saccharum officinarum* L.

**Introduction: -**

Cane yield and its component traits are highly affected by the environments. With the statistical and biometrical techniques developed to estimate stability parameters, it would be possible to determine genotypic response for wider adaptability. Techniques for GE analysis based on linear regression can be informative when GE interaction has high linear association with the environmental index but when the non linear component is also significant. (Finley and Wilkinson 1963 and Varma *et al 2007*). The analysis based on Eberhart and Russell model being relatively simple has been widely used for stability analysis. Estimation of GE interaction consists of complementary procedures classification and grouping the genotypes according to their response in different environments (Singh and Agrawal 2003). Genotype and environment interaction is important in understanding the stability in cane yield of a particular genotype before is being recommended for a given situation (Varma *et al* 2013). The present investigation was therefore conducted to find out the stability for cane yield and its component traits of promising sugarcane genotypes.

**Material and Methods: -**

The experimental material consisted of seven sugarcane genotypes namely, Co-6032, Co- 7023, Co-7025, CoH-7261, COLK -7201, COJ- 64 & Co-Pant - 84211 (COJ-64 & Co-Pant-84211 used as checks) were evaluated at Agricultural Research Station, Ummedganj, Kota, Rajasthan during 2010-11- to 2012-13 in randomized block design with three replications. The cultural practices as per the recommended package of practices were followed to raise good crops. The data were recorded onCane yield (q/ha), CCS (qt/ha), CCS (%) Juice, Brix (%), Sucrose (%) and Single cane weight (Kg). The cane yield was recorded on plot basis and was estimated in tones/ha. The three year data on each variety were used for estimation of stability parameters of different genotypes as per Eberhart and Russell model 1966. The sustainability index was estimated according to following formula used by other workers (Gangwar *et al*., 2004 and Verma *et al* 2013).

**Sustainability index =** Average performance of a genotype – Standard Deviation X 100

Best performance of a genotype in any year

The value of sustainability index were arbitrarily divided in to five group *viz*. very low (up to 45%), low (46– 60 %), moderate (61-75%), high (76-90) and very high (above 90%).

**Result and Discussion:-**

Pooled analysis of stability indicated that, genotype and environmental differed significantly for all the traits studied. Eberhart and Russel (1966) discussed, the stability of a genotype depends on three parameters namely, genotypic mean (X), regression or linear response (bi) and deviation from the linearity (S2di). According to this model an ideally stable genotype is one that confirms high mean value (>gi), unit regression or linear response (bi=1) and no deviation from the linearity (S2di = 0). The estimates of mean performance (x), regression coefficient (bi) and deviation from regression ((S2di) are presented in Table-1. Considering the stability of a genotype, the three parameters *viz*, grand mean over the environments (x), unit regression coefficient (bi=1) and squared deviation from the regression (S2di = 0) were considered stable in performance. The genotype CoH-7261 and Co-6032 was found stable for cane yield (q/ha) and CCS (q/ha). None of the genotypes were found stable for CCS (%) juice, the genotype Co-7025 exhibited better performance and bi< 1.0 indicating bellow average responsiveness for poor environments.

For Brix (%) the genotype CoH-7261 was also found stable, having unity regression and non-significant deviation from the regression, while the genotype CoLK-7201 had regression less than unity but deviation from regression non significant indicating that this genotypes may also be considered as stable for poor environments. For sucrose (%) and single cane weight (kg), the genotype Co-7025 and CoLK-7201 were found stable with unity regression and non-significant deviation from regression. Similar results have been reported for stability in sugarcane yield by many workers (Kimberg *et al* 2009 and Tiwari *et al* 2011).

The estimates of sustainability index analysis of variance for cane yield and other related traits revealed significant genetic variability in the genotype under study. The genotype CoH-7261 recorded highest mean cane yield (84.62 q/ha) with very high sustainability index of 94.20 % indicating best performance of this genotype (Table-2). The best performance coupled with high value of sustainability index could be taken as the indication of close proximity between the best performance and the average performance over the years. The second best genotypes was Co-6032 recorded mean performance of cane yield 80.19 q/ha and sustainability index of 92.08 % indicating better performance. For CCS % juice the genotype Co-7025 has highest mean value of 11.90 as well as sustainability index of 91.06 %. The other stable genotypes were CoH-7062 and Co-6032. For Brix % sucrose % and Single cane weight all the genotypes recorded higher sustainability index which indicated that, this chapter is least influenced by the environmental factors.

On the basis of best performance and high sustainability index the genotypes CoH-7261, Co-6032 and CoLK-7025 were found to be consisted over the years and quality traits are least affected by the environmental factors. Similar findings were earlier reported by Imtiaz *et al (*2013), Kumar et al (2004) and Guddadamath *et al* (2014) in sugarcane.

The comparative study of Eberhart & Russell model and sustainability index model, indicated that, the genotypes CoH-7261 and Co-6032 were found stable for cane yield based on the linear components (bi), non-linear response (S2di), high mean values and high sustainability index. These genotypes may be considered for cultivation so that the sugarcane productions can enhanced in the South-Eastern Plain Zone of Rajasthan for getting higher yield.

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**Table 1 - Estimates of stability parameters of cane yield and its components in sugarcane.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Genotype** | **Cane yield (q/ha)** | | | **CCS (q/ha)** | | | **CCS (%) Juice** | | | **Brix (%)** | | | **Sucrose (%)** | | | **Single cane weight (kg)** | | |
| **Mean** | **bi** | **S-2di** | **Mean** | **bi** | **S-2di** | **Mean** | **bi** | **S-2di** | **Mean** | **bi** | **S-2di** | **Mean** | **bi** | **S-2di** | **Mean** | **bi** | **S-2di** |
| Co-6032 | 80.19 | 0.81 | -0.8 | 9.65 | 1.11 | -0.1 | 11.80 | 0.46 | -1.0 | 19.76 | 0.79 | 0.00 | 17.22 | 0.78 | 0.0 | 0.98 | 0.58 | 0.0 |
| Co-7023 | 73.57 | 2.57\* | 2.5 | 8.14 | 1.47\* | -0.1 | 9.99 | 2.44\* | -0.3 | 18.80 | 1.26\* | -0.1 | 16.31 | 1.11 | 0.0 | 0.91 | 0.46 | 0.0 |
| Co-7025 | 79.98 | 1.46 | 1.7 | 9.51 | -0.15 | 1.1 | 11.90 | 0.24 | -0.8 | 20.09 | 1.68\* | 0.0 | 17.39 | 0.91 | 0.1 | 1.06 | 1.00 | 0.0 |
| CoH - 7261 | 84.62 | 1.21 | 0.7 | 10.39 | 0.92 | 0.1 | 11.75 | 0.62 | -1.1 | 20.28 | 1.16 | 0.2 | 17.29 | 1.15 | 0.1 | 1.10 | 1.07\* | 0.0 |
| Colk-7201 | 79.06 | -1.59 | 5.0\* | 9.37 | 1.28 | -0.1 | 1.86 | 0.24 | -0.7 | 19.94 | -0.47 | -0.1 | 17.31 | 1.04 | 0.0 | 1.06 | 0. 23 | 0.0 |
| COJ-64 | 69.74 | 3.95\* | 2.9 | 7.96 | 2.27\* | -0.1 | 10.35 | 2.63\* | 0.4 | 19.51 | 1.95\* | 0.3 | 16.78 | 0.90 | 0.1 | 0.858 | 1.67\* | 0.0 |
| Co-Pant-84211 | 73.49 | -1.42 | 5.5\* | 8.68 | 0.09 | 0.4 | 11.60 | 0.35 | -0.7 | 19.67 | 0.61 | -0.1 | 16.97 | 1.08 | 0.0 | 0.961 | 1.32\* | 0.0 |
| Pooled mean | 77.24 |  |  | 9.10 |  |  | 11.32 |  |  | 19.72 |  |  | 17.04 |  |  | 0.992 |  |  |
| Standard Error | 1.27 |  |  | 0.36 |  |  | 0.48 |  |  | 0.24 |  |  | 0.17 |  |  | 0.01 |  |  |

\*= Significant at 0.05 probability

**Table: 2- Estimates of sustainability index of cane yield and its components in sugarcane.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Genotype** | **Cane yield (t/ha)** | | | | **CCS (t/ha)** | | | | **CCS (%) Juice** | | | |
| **Mean** | **Õn** | **YM** | **Sustainability index (%)** | **Mean** | **Õn** | **YM** | **Sustainability index (%)** | **Mean** | **Õn** | **YM** | **Sustainability index (%)** |
| Co-6032 | 80.19 | 2.52 | 84.35 | 92.08 | 9.66 | 0.767 | 10.45 | 85.05 | 11.80 | 0.52 | 12.98 | 86.95 |
| Co-7023 | 73.57 | 3.68 | 79.84 | 87.54 | 8.15 | 0.572 | 9.24 | 81.96 | 10.00 | 3.37 | 12.26 | 54.11 |
| Co-7025 | 79.98 | 1.67 | 87.25 | 89.75 | 9.51 | 0.525 | 10.95 | 82.07 | 11.90 | 0.49 | 12.54 | 91.06 |
| CoH - 7261 | 84.62 | 4.23 | 85.34 | 94.20 | 10.40 | 0.851 | 11.00 | 86.79 | 11.76 | 0.72 | 13.12 | 84.08 |
| Colk-7201 | 79.06 | 3.46 | 84.51 | 89.45 | 9.38 | 0.462 | 10.96 | 81.72 | 11.87 | 0.53 | 12.92 | 87.71 |
| COJ-64 | 69.74 | 4.36 | 77.05 | 84.86 | 7.96 | 0.882 | 9.67 | 73.23 | 10.35 | 3.59 | 13.02 | 51.95 |
| Co-Pant-84211 | 73.49 | 3.01 | 79.45 | 88.71 | 8.69 | 0.531 | 10.01 | 81.01 | 11.61 | 0.45 | 12.28 | 90.85 |
| Pooled mean | 77.24 |  |  |  | 9.10 |  |  |  | 11.32 |  |  |  |
|  | **Brix (%)** | | | | **Sucrose (%)** | | | | **Single cane weight (g)** | | | |
| **Genotype** | **Mean** | **Õn** | **YM** | **Sustainability index (%)** | **Mean** | **Õn** | **YM** | **Sustainability index (%)** | **Mean** | **Õn** | **YM** | **Sustainability index (%)** |
| Co-6032 | 19.77 | 0.55 | 20.5 | 93.74 | 17.23 | 0.44 | 18.1 | 92.73 | 0.98 | 0.06 | 1.05 | 87.86 |
| Co-7023 | 18.81 | 0.50 | 19.53 | 93.74 | 16.31 | 0.51 | 17.42 | 90.69 | 0.92 | 0.07 | 1.02 | 82.62 |
| Co-7025 | 20.10 | 0.42 | 20.7 | 95.08 | 17.39 | 0.51 | 18.12 | 93.15 | 1.07 | 0.06 | 1.15 | 87.72 |
| CoH - 7261 | 20.28 | 0.84 | 22.19 | 87.61 | 17.30 | 0.57 | 18.55 | 90.17 | 1.10 | 0.10 | 1.21 | 82.97 |
| Colk-7201 | 19.95 | 0.29 | 20.34 | 96.62 | 17.31 | 0.60 | 18.45 | 90.59 | 1.06 | 0.06 | 1.15 | 86.85 |
| COJ-64 | 19.52 | 0.61 | 20.2 | 93.57 | 16.79 | 0.52 | 17.94 | 90.68 | 0.86 | 0.07 | 0.96 | 82.39 |
| Co-Pant-84211 | 19.68 | 0.39 | 20.2 | 95.48 | 16.98 | 0.49 | 17.63 | 93.50 | 0.96 | 0.06 | 1.05 | 85.71 |
| Pooled mean | 19.72 |  |  |  | 17.04 |  |  |  | 0.99 |  |  |  |