*Journal of Agrometeorology* 1(2) : 191-194 (December 1999)

# Varietal evaluation of soybean (*Glycine max* L. Merr) for yield stability under different environments

V. RADHA KRISHNA MURTHY, V. SATYANARAYANA , SHAIK MOHAMMAD, A.RAMACHANDRA RAO and M. SRINIVAS

Department of Agronomy, College of Agriculture , Rajendranagar, Hyderabad - 500 030

## ABSTRACT

Field experiment was conducted during *rabi* seasons in 1996 and 1997, summer 1997 and *kharif* 1997 in the state of A.P. in India. 5 diverse genotypes of soybean (*Glycine max* L. Merr) were evaluated for yield stability. The performance of genotypes was greately influenced by the varying environments. Eberhart and Russel's stability model indicated that soybean genotype MACS-201 was the most dependable with *bi* not significantly different from unity. $S\ di^2$ not significantly different from zero and yielding more than the general mean. Two genotypes MACS-58 and PK-472 were also stable and ranked next to MACS-201. The genotype MACS-13 was also stable but ranked next to these three genotypes. The genotype MACS-330 was low yielder and was not responsive to climate variations.

***Key words :*** Soybean varieties, Evaluation, Environment, Stability parameters

Of the nine prominent annual oilseed crops, soybean (*Glycine max* L. Merr) has the distinction to serve both as an oilseed crop and as a pulse rich in protein. It contains 20 per cent oil and 42 per cent protein, while it is also richly endowed with health improving ingredients like vitamins, minerals and essential amino-acids. Crop yield fluctuates much from season to season. Since, information is not available on stability performance soybean varieties under varying weather conditions, an experiment was conducted to study yield stability and genotype environment interactions.

## MATERIALS AND METHODS

The experimental site was categorised as Alfisol. It had 7.25 pH, and 0.13 $dSm^{-1}$ electrical conductivity. The nutrient status was low in available nitrogen (150 kg $ha^{-1}$) and medium in phosphorus (40 kg $P_2O_5$ $ha^{-1}$) and potassium (210 kg $K_2O\ ha^{-1}$). The treatments involved testing of five soybean genotypes at different times of sowing commencing from 15 October at 20 days interval upto 14 December in the *rabi* seasons during 1996 and 1997. These genotypes were also tested for their performance to 4 different sowing dates on 5 and 25 January, 14 February and 6 March in summer 1997. In the *kharif* season, sowing date comparisons were made for genotypic responses to 5 and 25 June, 15 July and 4 August 1997. The 20 treatment combinations laid out in randomised block design with three replications following recommended agronomic practices. Stability analysis was carried out following Eberhart and Russell (1966). The parameters of stability, viz., regression (bi) and deviation from regression ($S^2d$), were used to identify the ideal genotype for the place located at 18°50'N latitude, 77°58'E longitude at an altitude of 542.6 m and average annual rainfall of 780 mm.

## RESULTS AND DISCUSSION

### *Pooled analysis of variance of genotypes*

The pooled analysis of variance indicated significant genotypic diversification among the five varieties for their potential yielding ability (Table 1). The genotype MACS-201 was the most productive with a mean yield of 2237 kg $ha^{-1}$. The genotype MACS- 330 was the least yielder (1368 kg $ha^{-1}$). The mean difference in yield of these genotypes was measurably as high as 39 per cent. The mean sum of squares due to environmental affects indicated that the magnitude of seasonal influence was about 1.94 times more strong than the genotypic variation.

### *Interaction of genotypes and environment*

The significant interaction thereby confirmed that the phenotypic expression of soybean yield was reasonably influenced by the combined influence of both the varying seasons and the genotypic potential. The genotypic differences in yield of soybean and their further modification by the environment through its interaction have also been amply demonstrated by Raut *et al.* (1990), Taware *et al.* (1991), Raut *et al.* (1992) and Taware *et al.* (1994). These illustrations have all demonstrated that the genotypes, therefore, behaved differently under different environments and that different genotypes responded differently to a specific environment.

### *Joint regression analysis of variance*

The joint regression analysis of variance was highly significant. This indicates that the differences among regression coefficients for various genotypes on environmental variation were clear. Its partitioning into environment (linear) and genotype x environment (linear) also showed highly significant differences. But, the mean sum of squares due to environment (linear) was much higher in magnitude indicating that a major part of variation was due to linear regression. Therefore, it is clear that both predictable (linear) and unpredictable (non-linear) components contributed significantly to differences in stability among genotypes, while the former was predominant. The mean sum of square due to residual effect (pooled deviation) was not significant. This indicates the predominance of predictable component contributing to the differences in stability of the genotypes.

### *Stability parameters*

Three parameters viz., mean performance of a genotype in different environments, its linear regression on environmental mean ($b_i$) and standard deviation ($Sdi^2$) are used to measure the phenotypic stability of different genotypes (Table 2). Finlay and Wilkinson (1963) proposed linear regression slope as a measure of stability. But, Eberhart and Russell (1966) emphasised the importance of both regression and deviation in judging the persistence of varietal performance under different environmental conditions. They enumerated that the variety with high mean yield, unit regression coefficient ($b_i = 1$) and as small as possible deviation from regression ($Sdi^2$) will be stable. But, Samuel *et al.* (1970) and Paroda and Hayes (1971) reported that the linear regression measures simply the response of a particular genotype and the deviation from regression is the most suitable measure of stability. The lower the deviation, more stable is the variety. The stability parameters in the present investigation indicated that the genotype MACS-201 produced more yield than the general mean production over seasons with high bi of 1.11 indicating its responsiveness

**Table 1 :** Pooled analysis of variance of seed yield of soybean genotypes

| Source | df | Sum of squares | Mean sum of squares |
|---|---|---|---|
| Variations | 4 | 2025673.28965 | 506418** |
| Env + (Var. * Env) | 15 | 3004310.21773 | 200287** |
| Environments | 3 | 2943106.09818 | 981035** |
| Var. * Env. | 12 | 61204.11956 | 5100** |
| Environments (linear) | 1 | 2943106.09818 | 2943106** |
| Var. * Env. (linear) | 4 | 60318.69786 | 15079** |
| Pooled deviation | 10 | 885.42169 | 88 |
| Pooled error | 40 | 42994.44444 | 1074 |
| Total | 19 | 5029983.17595 | 264735 |

| Environmental index | *Rabi* 1996 | *Rabi* 1997 | Summer 1997 | *Kharif* 1997 |
|---|---|---|---|---|
| | 283 | 298 | -645 | 64 |

**Table 2 :** Stability parameters for different genotypes of soybean

| Genotypes | Stability parameters | | |
|---|---|---|---|
| | X | bi | $Sdi^2$ |
| MACS-201 | 2237 | 1.11 | -1046 |
| MACS-58 | 2166 | 1.07 | -1046 |
| PK-472 | 2146 | 1.06 | -1043 |
| MACS-13 | 2054 | 1.04 | -1066 |
| MACS-330 | 1368 | 0.71 | -729 |
| General mean | 1994.2 | | |

to better environment. But, this response was not measurably high since the regression coefficient was not significantly different from unity. The standard deviation was also not significantly different from zero. Therefore, this genotype could be ranked foremost for its better performance under varying seasonal conditions. Two genotypes MACS-58 and PK-472 were tied up in their yield potential with marginal differences producing 2166 and 2146 kg $ha^{-1}$ respectively. They also yield more than the mean production of all genotypes over the different seasons (Table 2). Their regression coefficients were also nearer to unity and their standard deviations were not significantly different from zero. Hence, the performance of these genotypes can also be regarded as stable over different environments. But, they can be ranked second and third after MACS-201 owing to the relatively low yielding ability. The genotype MACS-13 with similar characteristics ranked fourth in terms of it yielding ability. it ranked fourth in terms of its yielding ability. The genotype MACS-330 was the least productive. Its regression coefficient was less than unity (0.71) was not significantly different from unity. The standard deviation was also not significant. But, its least yield potential (1368 kg $ha^{-1}$) enforce it to be the least adaptive. Yet, considering its stable performance across different environments and its endowed ability to mature early in 72 to 77 days may go a long way in its adoption in intercropping systems and multiple cropping systems to squeeze in the shorter period available for its growth in utilizing the land more effectively.

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