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Theme 4. Biodiversity, conservation and genetic improvement of range and forage species
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Predicting the yield potential of Guinea grass (*Panicum maximum* Jacq.) genotypes across India through G x E analysis

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Introduction

A native of Africa, Guinea grass (*Panicum maximum* Jacq.) was introduced to almost all tropical countries as a source of animal fodder. It is an ideal forage plant being perennial in growth habit, grows well on a wide variety of soils and tolerant of shade and fire, but not to water logging or severe drought. It also responds quickly to fertilizer and watering. Because of these desirable features, guinea grass is well established throughout tropical countries of both hemispheres where it plays an important role in dairy production.

Owing to the cultivation of this crop in varied agro-climatic conditions it is very common to get varied relative performances from the same cultivars when they are evaluated in different environments or in different years. The variations that occur in the performance of cultivars are attributed to the effect of the genotype × environment (G × E) interaction (Haldane, 1946; Falconer and Mackay, 1996). The selection of genotypes to maximise yield when genotype rank changes occur across environments is complicated because of the complexity of genotype responses. This type of interaction reduces selection efficiency and the accuracy of cultivar recommendation (Crossa and Cornelius, 1997).

Though guinea grass is in cultivation throughout the world and a good variability is available, concerted efforts have not been made adequately to validate and interpret the effects of G x E interaction on green fodder yield. As a result, the genetic improvement in guinea grass for fodder yield and quality has become impasse. Hence an attempt was made to study the interactive effects between genotype and environment on green fodder yield.

Materials and Methods

The experimental material consisted of six advanced genotypes of guinea grass (three clones and three checks) evaluated from 2009 to 2012 under the aegis of AICRP on Forage Crops (ICAR), Jhansi in nine different locations comprising seven states across India with varied altitude ranging from 28 MSL to 750 MSL having different latitude and longitude. The year 2009 was considered as the year of establishment of the genotypes and the observations were recorded for three years from 2010 onwards up to 2012. The geographical details of the locations where the experiment was conducted are given below (Table 1).

Table 1: Details of experimental location

Genotype	Environments	Name of the centre/ state	Latitude(N)	Longitude(E)	Altitude (m)
TNGG 062	A	Faizabad, Uttar Pradesh	26° 47'	82° 12'	97
RSD GG 1	B	Bhubaneswar, Odisha	20° 15'	85° 52'	45
JHGG 09-01	C	Urulikanchan,\ Maharashtra	18° 29'	74° 8'	551
Riversdale	D	Mandya, Karnataka	12° 31'	76° 53'	678
PGG 616	E	Coimbatore, Tamil Nadu	11° 00'	77° 00'	411
Bundel Guinea 1	F	Dharwad, Karnataka	15° 27'	75° 05'	750
	G	Anand, Gujarat	22° 32'	73° 00'	39
	H	Ranchi, Jharkhand	23° 23'	85° 23'	651
	I	Vellayani, Kerala	8° 29'	76° 59’	28

The experiments were conducted in a randomized block design with three replications and were carried out between June and July 2009. The experimental unit consisted of five rows of 4 m length, with a spacing of 0.6 m between rows and 0.5 m between plants. Though all the genotypes were evaluated for fodder yield and quality traits such as, green fodder yield (q/ha), dry matter yield (q/ha), crude protein content (%) and crude protein yield (q/ha), only economic trait green fodder yield (q/ha) alone was considered while studying the effect of interaction between genotype and environment. Adaptability and phenotypic stability analyses were performed by the AMMI method as described in Zobel *et al*. (1988). All statistical analyses were conducted using CropStat 7.2 (IRRI, 2007).

Results and Discussion

The analysis reveals that the genotypes expressed highest yield potential of 2515 q/ha during 2010 and the performance of genotypes was found to be lowest with a yield potential of 1691 kg/ha during 2012. Generally all the genotypes were mostly interactive with different locations and years as revealed by varied IPCA values. To exemplify the effect of each genotype and environment, the AMMI1 (IPCA1 *vs*. Means) biplots are shown in Figure 1. In the Figures, the x-coordinate indicates the main effects (means) and the y-coordinate designates the effects of the interaction (IPCA1). Values closer to the origin of the axis (IPCA1) render a smaller contribution to the interaction than those that are further away. In this case (Figure 1), it appears that genotype JHGG 09-01 and check Riversdale despite their averages were among the lowest, showed greater stability in all the three years of testing across different environments. Therefore, these genotypes may be considered for the locations *viz*., Faizabad, Bhubaneswar and Vellayani with low input management conditions.

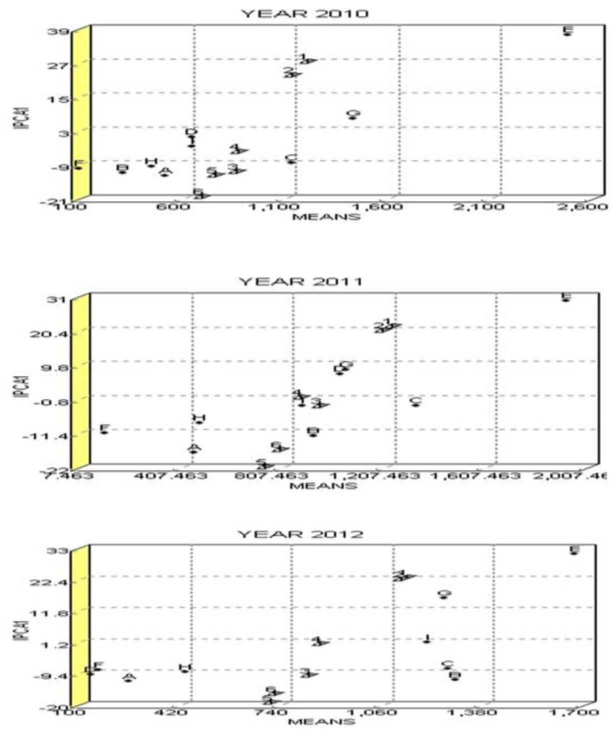

Fig. 1: AMMI biplot interaction with mean and IPCAI for green fodder yield over years and across location in India

On the other hand, the genotypes TNGG 062 and RSD GG 1 were the most unstable, with averages superior to the overall average and hence could be considered for locations with high input conditions. Out of nine locations with varied geographical positions, Anand centre (Gujarat) identified to be the stable location with a GFY level closer to overall average in all the years. The performance of entries in the Mandya centre (Karnataka) was highly unstable over the years. The genotype TNGG 062 was found to be the most suitable one for high input environments such as Coimbatore (Tamil Nadu) and Urulikanchan (Maharashtra).

The average values of Coimbatore (Tamil Nadu), Urulikanchan (Maharashtra) and Anand, (Gujarat) centres were higher than the overall average (906.8 q/ha), indicating that these locations were ideal and suitable for achieving higher biomass in guinea grass. Good precipitation and water distribution during the crop cycle, besides the relatively higher natural fertility of soils were the reasons that could be attributed for accomplishing high biomass in these cited locations.

Conclusion

It is inferred from the present study that, the two genotypes TNGG 062 and RSD GG 1 were recorded higher green fodder yield of 1171 q/ha and 1131 q/ha respectively than the check entries. While comparing the years, 2010 was comparatively better year with good precipitation than 2012. Among the locations, Coimbatore (Tamil Nadu) and Anand, (Gujarat) centres were found to be the most favorable environments for achieving higher green fodder yield potential of guinea grass.

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