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Estimates of Gene Effects for Some Important Qualitative Plant Traits in Maize Diallel Crosses

Muhammad Tariq Saeed and [1]Mohammad Saleem
Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad
[1]Pulses Research Institute, Faisalabad, Pakistan

Abstract: Nature of gene action was investigated for various agronomic characters such as plant height, ear height, number of days taken to tasseling and number of days tasseling in a set of complete diallel crosses, involving six elite maize inbred lines (B 70, EX 228, FR 15, N 28; PA 91, SYP 5). The Vr-Wr graphs indicated over-dominance type of gene action for ear height and additive type of gene action for all other traits. It was revealed that inbred line FR 15 and SYP 5 possessed most dominant genes fur plant height and ear height respectively. Similarly inbred line B70 contained most dominant genes for number of days taken to tasseling and number of days taken to silking. The three characters like plant height, number of days taken to tasseling arid number of days taken to silking were under the additive genetic control and mass selection can be practiced for these characters, whereas ear height was non-additively controlled and selection for these populations must be practiced with great care to develop pure breeding line.

Key words: Estimates, gene effects, important qualitative plant traits, diallel crosses, maize

Introduction

Maize is extensively grown in temperate, sub-tropical and tropical regions of the world. Its range of cultivation stretches from 50° N to 40° S latitude and at an altitude from sea level to 3300 meters high. Being a short duration cereal crop, it has attained top priority in the areas of high mountains especially the northern parts of the country, where chilling conditions and snowfall limit the growing period of other cereal crops.

In Pakistan, maize is grown on an area of 962.2 thousand hectares with an annual production of 1665 thousand tons and an average yield of 1730 kg/ha. The provinces of N.W.F.P and Punjab contribute 96% of the total area and 98% of the total production of maize (Anonymous, 1999). Maize occupies special position in the national economy and is used directly as human food in the daily diet of millions of people in the form of bread, cakes and porridge with the added premium of high protein quality in the kernel. The importance of maize as an industrial raw material is rapidly increasing.

The average protein content of maize grain is generally 9-10%. However, several improved types have been developed in U.S.A. which have 40% protein in grain (Walden, 1997).

Among the available techniques, diallel cross analysis is an efficient tool providing basic information on genetic mechanism. In the present study, it is proposed to obtain information on the natural gene action for some qualitative characters. This will help to identify the superior inbred lines of maize available in the department of Plant Breeding and Genetics.

Materials and Methods

The present research was conducted in the department of Plant Breeding and Genetics, University of Agriculture, Faisalabad during the year 1997 according to the diallel model of Hayman (1954) and Jinks (1954). The experimental material was comprised of the following six inbred lines of maize maintained at the gene bank, University of Agriculture. Faisalabad.

1. B 70
2. EX 228
3. FR 15
4. N 28
5. PA 91
6. SYP 5

The inbred lines were crossed in a diallel fashion during summer 1997 to obtain all possible single and reciprocal crosses. During the next growing season; spring, seeds of all possible crosses along with the parents were sown in a triplicated trial according to a Randomized Complete Block Design. Each entry was sown in two rows of 5 m length keeping row to row distance 60 cm and plant to plant distance 23 cm. Data for the following characters were recorded on ten guarded plants from each entry.

1. Number of days to tasseling
2. Number of days to silking
3. Plant height (cm)
4. Ear height (cm)

The data were subjected to analysis of variance and further evaluated for gene action according to Hayman (1954) and Jinks (1954).

Results and Discussion

Number of days taken to tasseling: The difference in respect of number of days taken to tasseling among the genotypes were highly significant. The regression line (Fig. 1) cuts the Wr-axis above the origin, which signifies the additive type of gene action conditioning this character. Inbred lien B 70 possessed the maximum dominant genes, while inbred line FR 15 carried most recessive genes. The results are in accord with the findings of Setty (1975), Ramamurthy (1980) and Arif (1990). However, the results differ from Kanaka (1982) who reported that this character was controlled by partial over-dominance.

Number of days taken to silking: Analysis of variance for number of days taken to silking shows that the differences

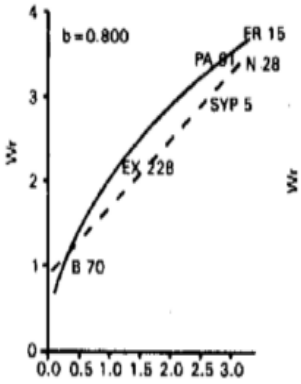

Fig. 1: Vr/Wr graph for no. of days taken to tasselling

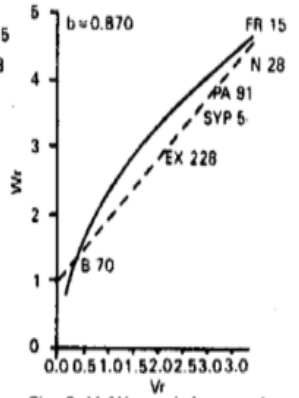

Fig. 2: Vr/Wr graph for no. of days taken to silking

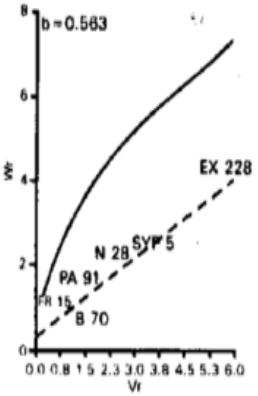

Fig. 3: Vr/Wr graph for plant height (cm)

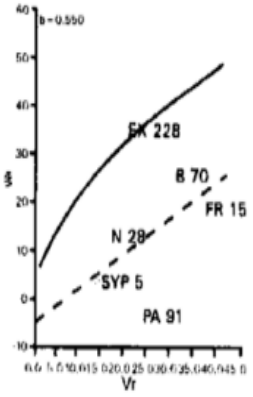

Fig. 4: Vr/Wr graph for ear height (cm)

among the genotypes were highly significant. The Vr-Wr graph (Fig. 2) shows additive type of gene action in the inheritance of this character. Inbred line B 70 possessed most dominant genes whereas inbred line FR 15 had most recessive genes controlling this character. These results are in accordance with the findings of Giriraj and Goud (1983) and Pfarr and Lamkey (1992), who reported additive genetic control for this character but differ from those of Dhillon *et al*. (1976) who reported over-dominance type of gene action.

Plant height: The differences among the genotypes regarding plant height were highly significant. From the graphical presentation (Fig. 3) it is clear that the regression line intercepted the Wr-axis just above the point of origin, suggesting additive type of gene action with partial dominance. Inbred line FR 15 carries most of the dominant genes and EX 228 contains maximum recessive genes. The results are in accordance with those of Setty (1975) and Ramamurthy (1980) who demonstrated that plant height was under the control of additive type of gene action. However, the results are in contrast to those of Akhtar (1971), Chaudhry (1964) and Saghir (1984) who reported over-dominance type of gene action for this character.

Ear height: Analysis of variance indicated that the differences among the genotypes were significant. From the graphical presentation (Fig. 4), it is clear that the regression line passes below the point of origin which shows the over-dominance type of gene action. Inbred line SYP 5 possessed most dominant genes, whereas inbred line FR 15 had most recessive genes. Ramamurthy (1980) and Sughroue and Hallauer (1997) reported that ear height was controlled by over-dominance type of gene action. However Singh *et al.* (1995) found that this character was under the control of additive type of gene action. Predictions in the case of additive gene action would be expected to he more reliable as compared to the characters which are controlled by non-additive genes. As suggested by Verhalen *et al.* (1971) a preponderance of non-additive effects would not favour mass selection in altering any of the traits but pedigree test, sib test, progeny test or various combinations among them, will certainly he required to improve these characters.

To conclude, it may be said that the overall information obtained in the present study if practiced with care can, in general, go a long way in developing promising synthetics and hybrids of maize.

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