Environment & Ecology 35 (2B) : 1104—1106, April—June 2017
Website : environmentandecology.com ISSN 0970-0420

Study of Heterosis for Grain Yield and Yield Attributing Characters in Pearl Millet (*Pennisetum glaucum* (L.) R. Br.)

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Received 11 July 2016; Accepted 10 August 2016; Published online 30 August 2016

Abstract The present experiment was carried out with the objective to assess the magnitude of heterosis for grain yield and yield attributing characters. The mean squares due to genotypes were highly significant for all the characters except number of tillers per plant. This indicated the existence genetic variability in the experimental materials for the characters under study. However, the cross AIB-9 × AIB-34 and AIB-9 × AIB-29 exhibited significant and desirable relative heterosis and heterobeltiosis for grain yield per plant, days to 50% flowers, plant height, average ear head girth, average earhead weight and dry fodder yield per plant.

Keywords Pearl millet, Heterosis, Heteobeltiosis, Relative heterosis.

Introduction

Pearl millet (*Pennisetum glaucum* (L.) R. Br.), the world's hardiest warm season cereal crop Globally it ranks sixth after rice, wheat,maize, barley and sorghum in terms of area [1] and share 42% of total world production [2]. Pearl millet is an indispensable arid and semi-arid crop of India cultivated as dual purpose (food and feed) crop in over 8.3 m ha ranking fourth among total cereals [3]. The present scarcity situation pearl millet cultivation is the heart of dry land agriculture, being C_4 plant it can utilize sunlight and water efficiently. Heterosis is a basic tool in improvement of any crop in the form of F_1 generation which provides detailed information about the desirable parental combinations in any breeding program and reflects a high degree of heterotic response. Heterotic studies can also be used for getting information about the increase or decrease of F_1S over better parent (heterobeltiosis). However, selection of superior parents represent the major step in development of high yielding new cultivars and the identification of superior hybrid combinations is another fundamental issue in hybrid breeding [4]. The major objective of the preseent study was to estimate the heterosis over better parents (heterobeltiosis) for fourteen characters is a half diallel mating design involving ten diverse genotypes of spring wheat. The studies were conducted for identify the best cross combination may be exploited through heterosis breeding program for improvement in yield component and quality traits.

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Materials and Methods

The experimental material comprised of ten parents (Restorer lines), their 45 crosses and two standard check hybrids (GHB-558, GHB-538) were evalauted in randomized complete block design with three replication during *kharif* of 2011-2012 at the Regional Research Station, Anand agriculltural University, Anand. Hybridization was done in the morning from 8.00 AM to 10.00 AM by hand pollination using protogyny nature of the crop. Heterobeltiosis (HB) as per cent deviation of mean performance of F_1 towards better parent in respect to desired direction. Relative heterosis (RH) expressed as per cent deviation of mean performance of F_1 from mid parents value , i.e. average value of female and male parents involved. Standard heterosis (SH) as percent deviation of mean performance of F_1 towards standard check in respect to desired direction.

Results and Discussion

The analysis of variance was performed to test the differences amongst parents and hybrids for all the eighteen characters. The results revealed that the mean squares due to genotypes were highly significant for all the characters except number of tillers per plant. The values for mean square due to genotypes were further partitioned into parents, hybrids, parents vs hybrids, checks vs hybrids and between checks for each character. Further, partitioning of mean squares due to genotypes revealed that the parents statistically differed among themselves for all the characters under study except number of total tillers per plant, number of effective tillers per plant, average leaf length, average leaf width, average grain weight per earhead, grain yield per plant and test weight (Table 1) . In case of hybrids, significant differences were observed for all the characters except number of total tillers per plant and number of effective tillers per plant. The values for mean square due to parents vs hybrids contrast were significant for days to 50% flowering, days to physiological maturity of grain, plant height, number of total tillers per plant, average internodes length per plant, number of leaves on main stem, average leaf length, average leaf width, average ear head length, average ear head girth, average ear head weight, average grain weight per ear head, grain yield per plant, test weight, dry fodder yield per plant and total protein content, thereby suggesting possibility of heterotic crosses for these characters. The mean squares due to checks vs hybrids comparison were significant for days to 50 % flowering, plant height,number of leaves on main stem, average leaf length, average leaf width, average ear head length, average ear head girth, average ear head weight, harvest index and total protein content, which suggested that for these characters F_1S under investigation statistically differed from the check hybrids superiority of F_1S in pearl millet was also reported earlier [5,6].

The results revealed that crosses AIB-9 × AIB-34, AIB-9 × AIB-29, AIB-3 × AIB-26 and AIB-19 ×AIB-26 depicted high estimates of both relative heterosis and heterobeltiosis for grain yield per plant, in addition to above crosses, crosses AIB-6 ×AIB-21 and AIB-4 ×AIB-26 also depicted high estimates of RH and SH, respectively. Among these crosses, crosses AIB-9 × AIB-34, AIB-9 × AIB-29 and AIB-26 also exhibited significant heterotic effect over both the check hybrids. All these crosses recorded higher grain yield,cross AIB-9 × AIB-34 had the highest grain yield followed by crossess AIB-9 ×AIB-29, AIB-4 × AIB-21 and AIB-6 × AIB-21. The crosses AIB-9 × AIB-34 and AIB-9 × IB-29 also exhibited significant and desirable heterotic effects (RH and HB)for days to 50% flowering, plant height, average earhead girth, average earhead weight and dry fodder yield per plant. And the cross AIB-9 × AIB-34 also exhibited significant and desirable heterotic effects (RH and HB) for number of effective tillers per plant, number of total per plant, average leaf width and average grain weight per earhead. the other promising crosses also depicted significant and desired RH and HB for days to 50% flowering, days to maturity, plant height, average internode length, average earhead length, average earhead girth, average earhead weight and dry fodder yield per plant similar findings were reported by Shah [7].

In short, the crosses which had higher estimates of Rh and HB for grain yield alsohad positive effect for average earhead length, average earhead girth, number of effective tillers per plant and average earhead weight. Therefore, heterotic effect for grain yield per plant was outcome of direct effect of these attributes, and could be outcome of indirect effect of other yield attributes like average earhead girth and average grain weight per ear head, and among the developmental characters, days to 50% flowering, days to maturity and plant height and average leaf width might have contributed indirectly. Therefore, heterotic effects for grain yield per plant could be result of combinational heterosis. However, positive and negative estimates of heterosis for rest of the component characters could have checked each other for outcome of the heterotic effects for grain yield. Hence, to obtain maximum heterotic effects for grain yield, desired level of heterosis of each component character need to be worked out. Among parental line genotypes, inbreeds AIB-9, AIB-21, AIB-34, AIB-26 and AIB-19 yielded the superior heterotic crosses for grain yield. The results confirmed the findings of earlier [8], while the present findings differed from the reports of [9] as they reported only positive heterotic effects for both RH and HB.

The per se performance of F_1S was higher than parents in desired directions for most of the characters suggesting the possibility for heterotic F_1S. The parental line AIB-21 had the maximum average ear head weight, grain yield per plant and dry fodder yield per plant. In case of F_1S, the highest average earhead length was observed with hybrid AIB-13 × AIB-29; while hybrid AIB-3 × AIB-19 had the maximum average earhead girth. The highest mean values were observed with hybrid AIB-9 × AIB-34 for grain yield per plant, number of total tillers per plant, number of effective tillers per plant and average internode length [9].

In consideration to outcome of present study, the promising F_1S AIB-9 × AIB-34 and AIB-9 × AIB-29 may be advanced, and selection may be delayed up to late segregating generations, when by dominance would be diluted and transgressive segregants may be identified for development of new promising inbreds/restorer lines. The restorer lines AIB-9, AIB-19, AIB-21, AIB-26 and AIB-34 may be extensively used in heterosis breeding program for development of commercial hybrids.

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