GENETIC EVALUATION OF $M_2 V_1$ GUINEA GRASS *(Panicum maximum Jacq.)* CLONES UNDER PARTIALLY SHADED CONDITIONS

By

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THESIS
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DECLARATION

I hereby declare that this thesis entitled "Genetic evaluation of M_2V_1 guinea grass (Panicum maximum Jacq.) clones under partially shaded conditions" is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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CERTIFICATE

Certified that this thesis entitled "Genetic evaluation of M_2V_1 guinea grass (Panicum maximum Jacq.) clones under partially shaded conditions" is a record of research work done independently by Smt. Santhipriya, G. under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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INTRODUCTION

INTRODUCTION

Livestock rearing, an important occupation of the farmers, plays a vital role in Indian agriculture. Cross-bred and upgraded animals require adequate and balanced nutrition for realising their production potential. The cost of feed accounts for about 70 per cent of the cost of milk production (Patel _et al._, 1976). Fodder provides the cheapest source of nutrients. Hence, for economic milk production sufficient amount of nutritious fodder should be included in the daily ration of milch animals.

The fodder production in the country is not sufficient to meet the requirements of the livestock population. In 1985, the deficiency in the total fodder requirement was about 43 per cent of dry fodder and about 73 per cent of green fodder (Hazra, 1989). In Kerala the deficit in the drymatter requirement comes to about 41 per cent (Shamsudeen _et al._, 1985).

The country has about four per cent of the cultivated area under cultivated fodder crops (Hazra, 1989) whereas in Kerala, cultivated fodder crops occupy less than 0.1 per cent of the net area sown (Anonymous, 1991). The opportunities for increasing the area under cultivated forages are remote because of the preferential need for human food. However, possibility exists for improved land productivity through appropriate management practices.

Areas under tree plantations are examples of the type of land under which fodder crops could be grown to increase the economic use of the land. It has been shown that some grasses can be introduced into coconut, rubber or oilpalm plantations without adverse effect on the trees. In rubber and oilpalm the potential for combining livestock production and crop production exists only in the early years of establishment of the crop owing to severe light competition for fodder under mature stands of trees. Vast areas of land under tree plantations still remain untapped.

In Kerala, there is ample scope for cultivation of fodder crops as intercrop in the partially shaded coconut gardens occupying 8.16 lakh hectares (Anonymous, 1991) which will go a long way in solving the fodder shortage of the State.

Coconut palm requires a spacing of 7.5 m x 7.5 m due to its canopy size. On area basis 75 per cent of the total available land in a pure palm stand is not effectively utilised by coconut roots and can support many other crops. Besides sunlight is not fully intercepted by coconut leaves at the early stages of growth (upto eight years) and after 20 years of growth of the coconut palm.

Intercrops raised can trap this unintercepted radiant energy (about 50%) and convert it into useful economic products (Thomas, 1976; Nair et al., 1976).

In a study conducted with several fodder grass species, guinea grass has been found to give the highest yields under 100, 70 and 27 per cent light intensity (Eriksen and Whitney, 1981). Guinea grass gave high yields in trials under oilpalm (Wahab and Ahmad, 1984) and rubber (Dissanayake and Waidyanatha, 1987).

In many coconut growing countries, several studies have been conducted to find pasture grasses best adapted under coconut palms. Guinea grass gave high yield in coconut gardens in trials conducted at CPCRI and Coconut Research Institute, Srilanka. Besides many workers have reported the superior adaptability of guinea grass over other fodder grasses in coconut garden environment (Boonklinkajorn and Duriyaprapan, 1977; Reynolds, 1978; Topark-Ngarm, 1984; Manidool, 1984 and Shamsudeen et al., 1985).

Identification of superior clones followed by vegetative propagation and multiplication can lead to immediate improvement in the level of fodder production in grasses like guinea grass where seed propagation need not be resorted to for multiplication. It is noted that highly heterogeneous genotypes exist in facultative apomictic grasses such as guinea grass (Filho, 1981) and the detection of superior individuals will be the main problem to be tackled. With this background the present investigation was taken up.

The base population of the present study consists of open pollinated seed progeny of FR-600, Makueni and four mutant clones selected in an earlier study by induction of mutation in FR-600. The seed progeny raised from open pollinated seeds obtained from closely planted mutant and parental clones of guinea grass was expected to be highly heterogeneous. Hence selection of individual plants based on forage yield, tiller count and root length would indicate superior genotypes. By replicated progeny trials, the genotypic superiority can be clearly distinguised from the environmental variability present in the population. Hence the present study was initiated with the objective of identifying genetically superior genotypes among seedling progeny raised from guinea grass clones with higher forage yield and adaptability under partial shade of coconut gardens.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Guinea grass (*Panicum maximum* Jacq.) is a highly variable perennial bunch grass. It is a native of tropical Africa (Bor, 1960 and Purseglove, 1975) which is widely planted in many tropical and subtropical areas and highly regarded as a pasture grass for its adaptability, persistence, productivity and palatability. As a drought resistant and hardy crop, guinea grass is suitable for cultivation under rainfed conditions in Kerala. Among the non-leguminous grass fodders, guinea grass having a protein content as high as 9.50 per cent is superior in composition. Besides, due to its high dry matter content it is favourable for making hay. The species comprises of mainly obligate or facultative apomictic tetraploids and occasionally, sexually reproducing diploids and facultative apomictic hexaploids (Combes and Pernes, 1970; Noirrot, 1986; Savidan *et al*., 1989). There is a wide variation in the somatic chromosome number of this crop viz., 16, 18, 32, 36, 48 (Bor, 1960; Combes and Pernes, 1970; Purseglove, 1975; Hanna, 1986; Komatsu and Suzuki, 1987).

Recent advances in biometrics has helped the plant breeders to obtain a better understanding of the genetics of yield and its components in the cultivated crops. The work done on graminaceous fodder crops and allied crops is reviewed below under the following headings:-

I. Variability

II. Heritability and Genetic advance

III. Proline content

IV. Selection Index

I. Variability

The efficiency of selection in any crop depends upon the extent of variability available. The phenotypic coefficient of variation (PCV) gives the total variability caused by the genotype, environment and their interaction. The genotypic coefficient of variation (GCV) alone expresses the real variability available in a group of individuals. A knowledge of genetic variability in respect of yield and its associated characters is very valuable in a planned breeding programme, since it helps in the choice of best yield determining attributes.

In sorghum, Swarup and Chaugale (1962) reported GCV estimates of 53.11 per cent for plant height, 95.88 per cent for fodder yield/plant and 36.05 per cent for panicle emergence. In intervarietal crosses conducted by Sindagi et al (1970) GCV values of 16.62 per cent and 19.70 per cent were observed for plant height. For fodder yield, they obtained GCV values of 44.63 per cent and 65.40 per cent respectively for the crosses, TBK x IC 3437 and TBK x IC 2397.

Phul *et al*. (1972) in their study of 40 genotypes of oats, noted the highest genotypic coefficient of variation for tiller number (14.65%) followed by fodder yield (10.31%). The GCV values for the other characters were 3.97 per cent for plant height, 6.89 per cent for leaf length and 8.76 per cent for leaf breadth in Ludhiana. They noted a considerable environmental influence on these parameters. At Hissar, the GCV values were 17.01 per cent for tiller number, 17.99 per cent for fodder yield, 6.24 per cent for plant height, 5.44 per cent for leaf length and 7.18 per cent for leaf breadth.

GCV values of 13.70 per cent for plant height, 29.20 per cent for straw yield, 24.60 per cent for number of productive tillers and 7.20 per cent for number of fingers were observed in ragi by Mahudeswaran and Murugesan (1973).

Sangha and Singh (1973) in their studies on bajra recorded GCV values of 12.22 per cent for number of tillers and 18.72 per cent for fodder yield.

In their studies with ragi, Appadurai *et al*. (1977) noted GCV values of 44.10 per cent for straw weight, 27.10 per cent for number of productive tillers and 9.80 per cent for plant height.

The GCV values obtained by Nair and Gupta (1977) in fodder oats were 8.64 per cent for plant height, 25.36 per cent for number of tillers, 27.77 per cent for total green yield and 8.71 per cent for total dry matter yield. Tyagi *et al*. (1977) observed GCV values of 28.94 per cent for plant height, 30.01 per cent for number of tillers/plant, 15.77 per cent for leaf/stem ratio, 24.51 per cent for green fodder yield and 37.07 per cent for dry matter yield.

Sethi and Singh (1978) in their studies with barley observed the highest GCV for tillers/plant (26.78%), followed by leaf area (25.65%), green forage yield (20.31%), dry matter yield (19.96%) and plant height (11.54%).

High GCV estimates were noted for the characters fodder yield, number of tillers and dry matter yield in *Echinochloa frumentaceae* (Mohamed, 1979).

Subramaniam (1979) noted high GCV for panicle number (24.63%) and tiller number (22.38%) in little millet.

High GCV values were observed for the characters plant height, leaf/stem ratio and fodder yield in ragi by Dhanakodi (1980).

Tyagi *et al*. (1980) noted the highest GCV estimate for green fodder yield (14.71%) in their studies with pearl millet. The GCV estimates for the other characters were

9.94 per cent for dry matter yield, 7.80 per cent for number of tillers and 5.57 per cent for plant height.

High GCV estimates were noted for number of tillers/plant, plant height and straw yield in fox tail millet by Viswanatha et al. (1981).

Reddy (1982) observed high GCV for straw weight and number of tillers in little millet.

High coefficient of variation was noted for forage yield in maize by Kumar (1982).

Mathur and Patil (1982) observed GCV estimates of 7.66 per cent, 26.08 per cent and 6.76 per cent respectively for plant height, number of tillers/plant and dry matter yield/plant in fodder sorghum.

High variability was observed for height and green matter yield in meadow fescue by Krolak (1983).

Martusewicz (1983) observed a high degree of variability for height and leaf dimensions in tall fescue.

High coefficients of variation were reported by Prakash (1983) for plant height, forage yield/plant and dry matter yield/plant in *Pennisetum typhoides*.

Singh and Patil (1983) observed GCV values of 9.84 per cent and 25.71 per cent for plant height, 12.10 per cent and 12.03 per cent for tillers/m row, 20.36 per cent and 27.69 per cent for leaf/stem ratio, 29.18 per cent and 33.06 per cent for green fodder yield and 32.04 per cent and 31.44 per cent for dry matter yield under irrigated and rainfed conditions respectively in fodder barley.

In guinea grass, Sreenivasan (1983) reported that maximum GCV was observed for dry weight (74.58%) followed by green fodder yield (71.29%), plant height (31.93%), leaf/stem ratio (27.75%) and number of tillers (21.83%). Low GCV was reported for plant height in millet by Liu (1984).

Mohan and Dua (1984) in their studies with pearl millet under single and double cut systems observed GCV values ranging from 9.71 per cent to 21.23 per cent for plant height, 4.34 per cent to 20.87 per cent for tiller number, 16.56 per cent to 17.82 per cent for green yield and 13.46 per cent to 23.66 per cent for dry matter yield.

In oats and barley, high variability was reported for plant height, green fodder and dry matter yields by Borgohain (1985).

Gaborcik (1987) observed high variability for leaf area and tiller number in tall fescue.

High genotypic variance for plant height in fodder sorghum was observed by Kaushik (1987).

Kulkarni and Shinde (1987) recorded high genetic variability for plant height and dry fodder yield in sorghum.

In a study of fodder oats, Rahaman and Roquib (1987) observed the highest genotypic coefficient of variation for green fodder yield. Plant height and tiller number/plant also had high GCV values.

Joseph (1988) in her studies conducted on the open pollinated seed progeny of guinea grass reported the maximum GCV for dry matter yield (24.03%) followed by inflorescence count (13.93%), leaf/stem ratio (13.31%), green fodder yield (11.68%), tiller count (3.23%) and plant height (2.30%).

Surprenant and Michaud (1988) observed significant genetic variation for plant height and dry matter yield in timothy grass.

Thejaseebhai (1988) in her studies with guinea grass recorded the highest GCV for green fodder yield/hill (26.22%) followed by number of panicles/plot (23.49%), leaf/stem ratio on dry weight basis (19.54%), dry matter yield/hill (17.21%), leaf/stem ratio on fresh weight basis (16.70%), green fodder yield/plot (16.15%), tiller number/hill (12.20%), dry matter yield/plot (11.37%) and plant height (6.52%).

II. Heritability and genetic advance

To determine the degree to which a character may be transmitted from parent to offspring and also to indicate the relative importance of heredity and environment on character variation, heritability serves as a useful statistical tool. Selection of characters on purely phenotypic basis without estimating the magnitude of heritable portion of it will result in failure. Estimation of heritability along with genetic gain is usually more useful in predicting the resultant effect through selection of the best individual.

Swarup and Chaugale (1962) observed high heritability values for plant height (98.36%) and fodder yield/plant (84.83%) in sorghum. The genetic advance for these traits were 108.53 per cent and 181.31 per cent respectively.

Heritability values ranging from 41 to 53 per cent and 44 to 53 per cent, respectively, for plant height and tiller number/plant among different crosses of sorghum and sudan grass were observed by Chandra (1970).

Sindagi et al. (1970) observed high heritability values for fodder yield (62.18% and 86.05%) and plant height (82.14% and 75.66%) respectively, for the crosses TBK x IC 3437 and TBK x IC 2397 in sorghum. The corresponding values for genetic advance were 72.47 per cent and 125.20 per cent for fodder yield and 36.81 per cent and 37.62 per cent for plant height.

Gupta and Gupta (1971) reported heritability estimates ranging from 5.02 per cent to 61.10 per cent for green fodder yield, 11.23 per cent to 72.74 per cent for leaf size and 0.00 to 88.94 per cent for plant height after investigations conducted on 18 promising germplasm lines of pearl millet, their crosses involving 3 MS lines and their F_2 progenies. Gupta and Nanda (1971) after studies conducted on Indian varieties, Indian inbreds, African varieties and African inbreds of bajra reported heritability values ranging from 29.96 to 63.12 per cent for green fodder yield, 31.35 to 54.18 per cent for leaf size, 43.28 to 93.24 per cent for plant height and 12.75 to 31.25 per cent for tiller number.

Heritability estimates of 45.51 and 33.56 per cent for plant height, 18.37 and 57.21 per cent for tiller number, 31.69 and 51.01 per cent for fodder yield at Ludhiana and Hissar respectively were observed by Phul *et al*. (1972) in fodder oats. The corresponding values for genetic advance were 3.62 and 8.63 per cent for plant height, 0.87 and 3.06 per cent for tiller number, 21.27 and 41.56 per cent for fodder yield.

Mahudeswaran and Murugesan (1973) observed heritability estimates of 90.30 per cent for plant height, 78.10 per cent for productive tiller number, 67.60 per cent for straw yield and 78.00 per cent for number of fingers in ragi. The maximum genetic gain was shown by straw yield (33.90 per cent) followed by plant height (19.50%), number of productive tillers (2.30%) and number of fingers (0.10%).

The highest heritability and genetic advance was recorded for fodder yield (0.93% and 37.18%) in pearl millet by Sangha and Singh (1973). The heritability value for number of tillers was 0.92 per cent and the value for genetic advance was 24.08 per cent.

Appadurai *et al*. (1977) observed heritability values of 72.50 per cent for straw weight, 51.40 per cent for number of productive tillers and 37.20 per cent for plant height in ragi. The corresponding values of genetic advance were 36.29 per cent, 1.55 per cent and 10.00 per cent respectively.

Heritability values of 95.29 per cent for tiller number, 92.07 per cent for plant height, 91.51 per cent for total dry matter yield and 90.74 per cent for green yield were observed in fodder oats by Nair and Gupta (1977). The corresponding values for genetic advance were 5.93 per cent, 25.44 per cent, 18.06 per cent and 88.56 per cent respectively.

Singhania *et al*. (1977) reported low heritability estimates for green forage yield/plant (11.00%), leaf/stem ratio (14.84%) and leaf area (16.2%) in sorghum.

High heritability values for leaf/stem ratio (99.78%), green fodder yield (91.38%), plant height (90.10%), dry matter yield (79.89%) and number of tillers/plant (73.79%) in fodder oats were reported by Tyagi *et al*. (1977). The corresponding values for genetic advance were 32.44 per cent, 47.64 per cent, 17.84 per cent, 54.44 per cent and 45.72 per cent respectively.

Tan *et al*. (1977) after their studies on *Bromus inermis* reported broad sense heritability values of leaf area (0.94), tiller density (0.86), canopy height (0.88) and yield (0.68).

Heritability values of 74.28 per cent for dry fodder yield and 31.72 per cent for green fodder yield were observed in pearl millet by Hooda *et al*. (1978).

Quesenberry *et al*. (1978) reported heritability estimates of 66.30 per cent for plant height in rhodes grass.

High heritability estimates for plant height (87.93%), tillers/plant (88.63%), leaf area (93.32%), green forage yield (87.50%) and dry matter yield (86.93%) in barley were observed by Sethi and Singh (1978). The corresponding values for genetic advance were 15.79 per cent, 7.60 per cent, 16.63 per cent, 57.57 per cent and 11.79 per cent respectively.

Tan et al. (1978) reported broad sense heritability values of 68.00 per cent and 49.00 per cent for fodder yield in the first and second cuts in brome grass.

High broad sense heritability as well as high genetic advance for number of tillers, fodder yield and dry matter yield in Echinochloa frumentaceae was reported by Mohamed (1979).

Vaithalingam (1979) reported moderate heritability values for leaf/stem ratio, green fodder yield and dry fodder yield in sorghum.

Heritability estimates of 0.47 for total dry weight yields and 0.40 for number of flower stems was reported in Andropogon gayanus (Anonymous, 1980).

Tyagi et al. (1980) in their studies with pearl millet, noted the highest values for heritability and genetic advance for green fodder yield (66.48% and 24.64% respectively) in pearl millet. They observed heritability values of 65.05 per cent for plant height, 37.27 per cent for number of tillers and 22.01 per cent for dry matter yield. The corresponding values for genetic advance were 9.24 per cent, 9.81 per cent and 9.61 per cent respectively.

Narrow sense heritability estimates ranging from 37.98 to 55.42 per cent for plant height, 10.50 to 14.67 per cent for green fodder yield and 9.29 to 14.91 per cent for dry fodder yield was observed by Sharma *et al*. (1981) in a study conducted at four environments in sorghum.

Viswanatha *et al*. (1981) reported moderate to high heritability and moderate genetic advance for yield contributing characters in foxtail millet.

Narrow sense heritability estimate of 75.00 per cent was reported for plant height in Indian grass by Vogel *et al*. (1981).

In little millet, Reddy (1982) observed high heritability and expected genetic advance for straw weight.

Kumar (1982) observed high heritability and expected genetic advance values for green and drymatter yield per plant in bajra.

In a study conducted in fodder sorghum, heritability values of 70.52 per cent for drymatter yield, 54.70 per cent for plant height and 49.22 per cent for number of tillers/plant were observed by Mathur and Patil (1982). The corresponding values for genetic advance were 11.69 per cent, 11.67 per cent and 37.69 per cent respectively.

High heritability was recorded for plant height in finger millet by Shankar (1982).

Singh (1982) observed high heritability estimates for plant height and forage yield/plant in jowar.

Low estimates of narrow sense heritability in the tillering traits in barley was reported by Bainiwal et al. (1983).

Berg and Hill (1983) reported heritability estimates of 0.40 for fodder yield and 0.75 for percentage dry matter in timothy.

High narrow sense heritability estimates for leaf area expansion rate in tall fescue was observed by Bughrara and Sleper (1983).

Prakash (1983) observed that plant height, forage yield/plant and dry matter yield/plant had high broad sense heritability values and high genetic advance in *Pennisetum typhoides*.

In sand blue stem, Riley and Vogel (1983) reported heritabilities of 0.28 for yield and 0.62 for heading height.

Sachs and Coulman (1983) observed broad sense heritabilities of 0.54 for height and 0.49 for panicle number in reed canary grass.

In barley, Singh and Patil (1983) reported heritability estimates for plant height (58.61 and 89.99%), tiller number (26.61 and 46.75%), leaf/stem ratio (2.75 and 15.10%) green forage yield (55.10 and 44.90%) and dry matter yield (72.04 and 43.98%) for irrigated and rainfed conditions respectively. The corresponding values of genetic advance were 14.99 and 50.20 per cent for plant height, 12.89 and 16.97 per cent for tiller number, 12.15 and 22.15 per cent for leaf/stem ratio, 44.62 and 45.33 per cent for green forage yield and 55.82 and 93.15 per cent for dry matter yield.

Talbert *et al.* (1983) reported narrow sense heritability estimates ranging from 0.76 to 0.82 for plant height and 0.25 for dry weight in switch grass.

Broad sense heritability of 40 per cent was reported for fodder yield in the quack grass x blue bunch wheat grass hybrid by Asay and Hansen (1984).

Bugge (1984) observed heritability estimates of 0.48 for dry matter yield/plant in *Lolium multiflorum*.

Heritability estimates of 0.63 for fodder yield was reported in sand bluestem by Glewen and Vogel (1984).

Goncharinko *et al.* (1984) in their studies on selection of divergent types for plant height in rye, reported coefficients of realized heritability of 0.38 to 0.73 per cent for long straw and 0.02 to 0.17 per cent for short straw after selection. Genetic advance following selection was 8.6 to 9.9 per cent for long straw and 0.5 to 2.1 per cent for short straw.

Liu (1984) recorded high broad sense heritability values for plant height in millets.

High heritability estimates for leaf size and leaf/stem ratio in fodder oats was observed by Manga and Sidhu (1984).

Mohan and Dua (1984) in their studies with pearl millet recorded heritability estimates ranging from 45.42 to 52.69 per cent for plant height, 0.47 to 33.56 per cent for tiller number, 18.78 to 25.16 per cent for green yield and 15.27 to 28.02 per cent for dry matter yield for different cuts. The values for genetic advance ranged from 14.07 to 31.75 per cent for plant height, 0.52 to 24.88 per cent for tiller number, 15.91 to 17.11 per cent for green yield and 10.94 to 25.80 per cent for dry matter yield.

High heritability and genetic advance for plant height and straw yield was observed in Italian millet by Rao *et al*. (1984).

Subramaniam and Rathinam (1984) reported heritability estimates ranging from 90.50 to 93.10 per cent for plant height and 69.90 to 74.90 per cent for straw yield/plant for the different seasons in rice.

In oats, Singh et al. (1987) reported moderate heritability for tiller number.

High heritability and genetic advance for plant height and green forage yield in oats was reported by Choubey and Gupta (1987).

High heritability and genetic advance was observed for plant height in sorghum by Kaushik (1987).

In oats, Kishor and Paroda (1987) reported that green leaf weight, green stem weight, dry leaf weight and dry stem weight were moderately heritable. Rahaman and Roquib (1987) reported moderate heritability for plant height and low heritability for tiller number. High heritability coupled with high genetic advance for tillers/plant and plant height was reported by Bahl et al. (1988).

In guinea grass, Joseph (1988) observed heritability values of 43.67 per cent for tiller count, 11.70 per cent for plant height, 56.16 per cent for inflorescence count, 39.37 per cent for leaf/stem ratio, 55.56 per cent for dry matter yield and 51.81 per cent for green fodder yield. Genetic advance was highest for inflorescence count (21.51%) followed by green fodder yield (17.30%), leaf/stem ratio (17.23%), tiller count (4.39%), dry matter yield (3.46%)

and plant height (1.63%). Thejaseebhai (1988) reported heritability estimates of 54.65 per cent for plant height, 32.47 per cent for number of tillers/hill, 82.45 per cent for number of panicles/plot, 59.98 per cent for leaf/stem ratio on fresh weight basis, 66.32 per cent for leaf/stem ratio on dry weight basis, 53.65 per cent for green fodder yield/hill, 40.03 per cent for green fodder yield/plot, 35.93 per cent for dry matter yield/hill and 23.66 per cent for dry matter yield/plot.

The corresponding values of genetic advance were 17.83 per cent, 1.35 per cent, 6.76 per cent, 0.18 per cent, 0.25 per cent, 84.59 per cent, 7.16 per cent, 9.49 per cent and 0.84 per cent respectively.

III. Proline content

Accumulation of free proline, an amino acid in plants experiencing water stress has drawn widespread attention of scientists. In certain cultivars, accumulation of proline during water stress and its rapid hydrolysis on rewatering are taken as indices for drought sustenance and recovery vigour respectively. It has been noted that accumulation of proline *per se* may not indicate drought adaptation. However, cultivars with high proline content at same level of leaf water potential are desirable.

In bean, Stewart (1971) reported that wilting causes proline accumulation by decreasing protein synthesis and by increasing proline formation. But immediately after rehydration, the levels of proline declines as the non-protein proline is incorporated into protein or oxidised to α isoglutarate (Stewart, 1972a). Stewart (1972b) reported that extensive oxidation of proline occurs only when the endogenous concentration of proline was increased substantially.

In sorghum, Blum and Ebercon (1976) reported that free proline accumulation during water stress was significantly correlated with post-stress recovery rating.

Andrew et al. (1977) after their studies in barley suggested that reports of a simple positive correlation between proline accumulating potential and drought resistance in barley might be in error. The increase of free proline at any point in a barley leaf tracks the decline in water status at that point. On relief of water stress, free proline levels declined in viable leaf tissue but remained high in the drought killed leaf zone. Hence, proline accumulating potential should not be utilised as a positive index of drought resistance in screening methods for cereal breeding programmes.

Mehkri et al. (1977) found that in groundnut, genotypic differences existed in the ability to accumulate proline. They observed a positive correlation between the magnitude of free proline accumulation and drought tolerance.

In cotton, McMichael and Elmore (1977) found that free proline accumulated to about one hundred times the concentration in the well watered controls as the stress increased.

Rajagopal et al. (1977) found that accumulation of proline in wheat plants under stress was about ten fold as compared to non-stressed plants.

Stewart (1977) attributed the increased concentration of free proline in water stressed tissues of the bean leaves to the lower rates of proline oxidation under conditions of water deficit.

In his studies with rape seed, Richards (1978) found higher proline accumulation in the drought resistant genotypes than in the drought sensitive genotypes.

In barley, Hanson et al. (1979) reported that proline accumulation is a symptom of severe internal water stress and apparently has no survival value during drought. Proline accumulation is a heritable trait. Selecting barley for low proline accumulation may help to identify material suitable for drought prone environments. Reliable detection of genetic differences in proline accumulation requires strict environmental control.

Parameswara and Krishnasastry (1980) observed that in sorghum the magnitude of proline accumulation was high when stress was induced at initial vegetative phase and low when induced at other stages.

In their studies with cotton, Elmore and McMichael (1981) observed that cultivars differed greatly in their ability to accumulate free proline during stress. Leaves accumulated more proline than cotyledons. Proline accumulation was also found to be positively correlated with the nitrogen status of the tissue.

Bhale _et al_. (1982) observed heterotic response for proline accumulation during stress in sorghum.

In wheat seedlings, Pandey (1982) observed that although the proline content increased with water stress in both drought resistant and drought sensitive cultivars, the proline accumulation was significantly greater in the drought resistant cultivar.

Chelkowska and Zielinska (1983) reported that leaf proline content showed a seven fold increase during stress in barley seedlings.

In pigeon pea, Nilima and Malik (1983) found that hardened plants gave higher yield under stress than unhardened plants which had also lower proline content.

Johnson et al. (1984) reported higher proline content in drought resistant cultivar than in the drought susceptible cultivar of wheat.

In sugarcane, Delgado et al. (1984) found an increase in leaf proline content with increasing water stress.

Sairam and Dube (1984) observed that although proline increased under stress in all the wheat varieties, varieties that accumulated more proline showed stress symptoms at much lower soil moisture regimes. Proline accumulation had no direct effect on yield.

After studies conducted in rice, Goyal et al. (1985) reported that free proline content increased with increasing water stress in all the genotypes but the increase was more marked in the drought tolerant genotype. The absolute level of free proline in drought tolerant genotype is lower.

Bhaskaran et al. (1985) reported that in sorghum, water stress caused an increase in the proline level. But the magnitude of the increase was not correlated with stress tolerance of the varieties.

In wheat, Cao and Lu (1985) observed that soil drought increased the free proline content. Proline content increased faster in the drought susceptible cultivars than in the drought resistant cultivars.

In wheat, Mokhashi (1985) found a positive correlation between free proline accumulation in the plant tissues and 1000 grain weight.

Nalawade and Chavan (1985) reported that moisture stress increased proline content in niger.

In stressed potato plants, Bansal and Nagarajan (1986) found that proline accumulation in leaves was negatively correlated with tuber weight and tuber number.

Chowdhury and Choudhuri (1986) found that in jute, proline accumulation was higher and earlier in drought tolerant than in drought susceptible cultivars. Faster decline in proline content after removing stress was also in the drought tolerant type.

In cluster bean, Kuhad and Sheoran (1986) reported that water stress increased the proline content.

Newton et al. (1986) found that proline content increased in callus of Pinus taeda when subjected to drought stress.

Proline was found to increase with increasing stress symptoms in cherry by Schmid and Feucht (1986).

In barley, Sinha and Patil (1986) observed that productivity under drought conditions was directly and positively associated with proline content.

Free proline content increased in response to water stress in Phaseolus vulgaris (Velasqez-Mendoza, 1986) and maize (Garcia et al., 1987).

Ivanov et al. (1987) reported that in wheat, yield was correlated with free proline content in the leaves under drought conditions.

In wheat, Monneveux and Nemmar (1987) observed that drought resistant cultivars had higher proline content. Overall leaf proline content was inversely related to rainfall and directly related to maximum daily temperature.

Rao and Raj (1987) found that, in sorghum, proline accumulation was maximum during the vegetative phase. Cultivars which had higher proline content recovered faster after release of stress.

After observations in maize roots, Thakur (1987) reported that proline accumulation increased more in drought resistant cultivars during moisture stress.

Girou and Curvetto (1988) after their studies in wheat found that the ranking of cultivars for proline accumulation during heading to anthesis was opposite to that observed during grain filling. There was no relationship between proline accumulation capacity and drought tolerance.

After their studies in soyabean, Guo et al. (1988) suggested that low proline content during water stress could be a criteria in selecting for drought resistance.

Although proline accumulated in green leaves of seedlings under drought stress, it was not correlated with cultivar or population tested in maize, as reported by Ibarra-Caballero et al. (1988).

In sorghum, Sivaramakrishnan et al. (1988) reported that the resistant lines accumulated more proline mostly after the cessation of growth. More proline was found in the green matter than in the fired portions of the leaves.

Anitha (1989) reported in greengram that there was no significant difference among the varieties in their proline content. Maximum proline accumulation was observed in the variety having the highest yield per plant. High GCV values (19.90%) were recorded for this character. The environmental influence over this character was high. Proline content exhibited low heritability values (20.83%) and moderate genetic gain (18.71%). Proline content had positive correlation with yield and negative correlation with haulm yield.

In cowpea, Mereena (1989) reported varietal differences for proline accumulation. High yielding variety had relatively low levels of proline. Proline content had high GCV (35.37%), high heritability (73.00%) and high genetic advance (62.20%). Grain yield and haulm yield per plot had high negative correlation with proline content.

Sudharani (1989) reported that in blackgram, there was a significant difference in proline content of the various varieties studied. Proline content recorded high GCV values (38.55%), moderate heritability (40.44%) and high genetic advance (50.51%). Grain yield per plot had high positive correlation with proline content.

IV. Selection Index

Selection Index is used for the purpose of population improvement by maximising the correlation between the index and the aggregate breeding value. An aggregate breeding value is a combination of breeding values of the traits to be improved, with each trait being weighed with its associated economic value. Indices are linear functions of phenotypic values of traits with each value having a corresponding index coefficient.

An investigation carried out to formulate a selection index in blue panic grass revealed that among the four characters studied for correlation with yield of green matter, the traits such as leaf width, number of tillers and height of plants appeared to exert the maximum influence, the relative contribution being in the order mentioned (Vaidyanathan, 1973).

Singh and Singh (1974) reported that in fodder sorghum, the indices based on single character were not superior to direct selection for fodder yield. The best selection index which included leaf length, stem girth, stem length, number of internodes and fodder yield resulted in 20.34 per cent increase over direct selection.

In ragi, the efficiency of indices over direct selection in terms of predicted genetic advances ranged from 93.80 to 118.30 per cent. But there was no significant difference between test trial yields of index selected and directly selected lines, according to Mishra and Patnaik (1984).

Reddy and Gupta (1986) after their studies on guar, reported that, the highest selection efficiency which was 55.00 per cent higher than that of straight selection for seed yield was shown by an index comprising of yield/plant, branches/plant, pods/plant and crude endosperm percentage.

The multistage index may be useful as a selection tool to reduce research costs, through selection in preliminary stages and elimination of unselected individuals from further testing and to provide gains comparable to those expected from single stage index selection. In forage crop breeding, multistage indices have the potential to be used in selecting initial growth and regrowth traits to make considerable savings in time, labour and other inputs (Godshalk *et al*., 1988).

MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigation was carried out in the Department of Plant Breeding, College of Agriculture, Vellayani.

A. MATERIALS

The base material of the present study consisted of open pollinated seed progeny of two known superior clones namely FR-600 and Makueni and four mutant clones (MC-2, MC-14, MC-16 and MC-23) selected earlier by induction of mutation in the variety FR-600 of guinea grass.

B. METHODS

I. Evaluation of the base material

The open pollinated seed progeny of the four mutant varieties, FR-600 and Makueni raised during 1986 June were evaluated for fodder yield and adaptability by taking the following observations on the surviving plants in 1988.

1. Green fodder yield

The green fodder yield per clump was noted for two cuttings, the first cutting in rainy season and the second cutting at the end of the summer season.

2. Tiller count

The tiller count per clump was noted at the time of two harvests, the first during the rainy season and the second at the end of the summer season.

3. Drymatter yield

A random sample of green fodder was taken from each of the six varieties at the time of each harvest and sun-dried to a constant weight and the drymatter percentage computed. Based on this estimate, the drymatter yield per clump was worked out for two cuttings, the first during the rainy season and the second at the end of the summer season.

4. Root length/clump

The clumps were uprooted carefully after soaking the soil and the length of the longest root was measured and recorded.

The top ranking ten clumps based on green fodder yield, drymatter yield, root length and tiller count from each of the six clones was selected for clonal progeny analysis. Progenies were selected based on the performance indices in different families, such that, ten progenies were selected from each family, irrespective of the replication.

II. Clonal progeny analysis

The clumps consisting of 60 numbers, selected from the base material was planted for clonal progeny analysis in a compact family block design with four replications in a coconut plantation. Six clones each with ten progenies were planted at a spacing of 40 cm x 20 cm. Each progeny comprised of lines of ten plants.

The crop was raised adopting "Package of Practices recommendations (Anon., 1986) of the Kerala Agricultural University".

The following observations were taken:

1. Height

The plant height was measured on a random sample of five plants/treatment at the time of each harvest. The height was measured in centimetres from the base of the plant to the tip of the tallest leaf excluding the boot leaf.

2. Tiller count

The total number of tillers on a random sample of five plants/treatment was counted and recorded at the time of each harvest.

3. Leaf/stem ratio

During each of the four harvests, a random sample was taken from each of the plots. separated into leaf and stem portions, weighed and the ratio worked out.

4. Leaf area

At the time of each harvest, five fully expanded topmost leaves were taken from each treatment, the leaf area was measured using a leaf area meter and the mean recorded in square centimetres.

5. Root length

The plants were uprooted carefully after soaking the soil and the length of the longest root was measured in centimetres on a random sample of five plants/treatment.

6. Proline content

The sun-dried leaves of the third harvest was oven dried at 60°C for 24 hours and powdered well. The analysis for free proline content of leaves was done as per the procedure suggested by Bates et al. (1973) and the results calculated on a dry weight basis and expressed as μg. proline/g. of dry weight material.

7. Inflorescence count

The total number of inflorescences in each of the treatments was counted and recorded at the time of each harvest.

8. Reaction to pests and diseases

The reaction to the disease collar rot caused by *Rhizoctonia solani* which occurred at the time of transplanting was noted by taking the count of the surviving plants.

9. Green fodder yield

The green fodder yield of each of the treatments consisting of ten plants was noted for four harvests, the first harvest being done 75 days after transplanting and the subsequent three harvests at 45 days interval. The green fodder yield of each of the treatments was weighed separately and expressed in grams.

10. Drymatter yield

During the four harvests, a random sample was taken from each of the treatments and sun-dried to a constant weight and the drymatter percentage was computed. Based on this estimate, the total drymatter yield was worked out.

11. Soil moisture status

The soil samples were taken from each of the main plots of size 4m x 2m during the peak summer months, and the soil moisture percentage was determined by the gravimetric method.

12. Weather parameters

The weather parameters namely total rainfall, mean relative humidity, mean maximum temperature and mean minimum temperature received during each of the crop growth periods between two harvests were also recorded.

C. Statistical techniques

I. Estimation of the performance indices

The observations taken on the base material, namely green fodder yield, drymatter yield, root length and tiller count were recorded and weighted with a factor $wi = \frac{1}{\sigma_i^2}$, which is the reciprocal of the variance for each character. The performance of the ith genotype was estimated as

$$Pi = \sum_{j=1}^{n} Wi\ Xij$$

where Wi measures the information supplied by the character X_i and X_{ij} is the observation recorded for ith genotype with respect to jth character.

Based on the Pi values for each clump, the top ranking ten clumps from each of the six families were selected for clonal progeny analysis.

II. Analysis of variance

Analysis of variance (Table 1) was done as per the design (Panse and Sukhatme, 1957) for the following objectives:

(i) for the comparison among the different families

(ii) for the comparison among progenies within families, and

(iii) to estimate the variance components

The extent of phenotypic variance for any character is the sum of the genetic and environmental variance.

Table 1. Analysis of variance

For each family the following ANOVA is done

Source	df	MS	F
Between replication	r-1	MSB	
Between progenies	p-1	MSP	
Error	(r-1) (p-1)	MSE	

If the error variances are found to be homogeneous then the following pooled ANOVA is done

Source	df	MS	F
Between replication	r-1	MSB	
Between families	n-1	MSF	
Error (1)	(r-1) (n-1)	MSE_1	
Between progenies within families	n(p-1)		
Error (2) pooled	n(p-1) (r-1)	MSE_2	

The genetic variance existing between progenies is worked out

as $\sigma g^2(x) = \frac{MSP - MSE}{r}$

$$V(P) = V(G) + V(E)$$

$$\sigma^2_{p(x)} = \sigma^2_{g(x)} + \sigma^2_{e(x)}$$

where $VP = \sigma^2_{p(x)}$ = variance due to phenotype

$V(G) = \sigma^2_{g(x)}$ = variance due to genotype

$V(E) = \sigma^2_{e(x)}$ = variance due to environment

III. Coefficient of variation

The coefficient of variation is a unitless measurement and is used for comparing the extent of variation between different characters measured on different scales.

Phenotypic coefficient of variation (PCV)

$$\text{PCV for character } x = \frac{\sigma_{p(x)}}{\bar{x}} \times 100$$

Genotypic coefficient of variation (GCV)

$$\text{GCV for character } x = \frac{\sigma_{g(x)}}{\bar{x}} \times 100$$

where $\sigma_{p(x)}$ and $\sigma_{g(x)}$ are the phenotypic and genotypic standard deviation respectively and $\bar{x}$ is the mean of the character.

IV. Heritability (H^2)

Heritability in the broad sense (H^2) is the fraction of the total variance which is heritable and was estimated as a percentage as

$$H^2 = \frac{\sigma g^2(x)}{\sigma p^2(x)} \times 100$$

and provides a measure of genetic variance i.e., the variance upon which all the possibilities of changing the genetic composition of the population through selection depends.

V. Genetic advance under selection (G.A)

Genetic advance is the measure of the change in the mean phenotypic level of the population produced by selection and depends upon the heritability of the character and selection differential. Genetic advance for character x is estimated as

$$GA = KH^2 \sigma p(x) \quad \text{(Allard, 1960)}$$

where GA = genetic advance and

K = selection differential

= 2.06 in the case of five per cent of selection in large samples.

VI. Selection Index

A selection index was formulated by discriminant function analysis on the basis of characters making significant contribution to fodder yield so as to discriminate the desirable genotypes from the undesirable ones on the basis of their phenotypic performance (Singh and Choudhary, 1977).

The genetic worth of an individual (H) is defined as

$$H = a_1G_1 + a_2G_2 + --- a_nG_n$$

where $G_1, G_2 --- G_n$ are the genotypic values of individual characters and $a_1, a_2 ---- a_n$ signify their relative economic importance. Another function (I) based on phenotypic performance of various characters was defined as

$$I = b_1P_1 + b_2P_2 + \ldots\ldots b_nP_m$$

where $b_1, b_2, \ldots . b_n$ are to be estimated such that the correlation between H and I i.e., r (H, I) is maximum. Once such a function is obtained it is possible to discriminate desirable genotypes from the undesirable ones on the basis of their phenotypic performance i.e., $P_1, P_2, \ldots . P_m$ directly.

The coefficients b_i are estimated from the solution of the equations

$$(\underset{\sim}{P_{ij}})\ \underline{b} = (\underset{\sim}{G_{ij}})\ \underline{a}$$

where $(\underset{\sim}{P_{ij}})$ and $(\underset{\sim}{G_{ij}})$ are the matrices of phenotypic and genotypic performances and $\underline{a}$ is the economic weight assigned to each character.

In this particular case, yield and four other characters contributing to yield were selected and assuming

$a_1 = a_2 = a_3 = a_4 = a_5 = 1$ the selection indices were worked out

The mathematical description of the function (I) is known as the selection index.

$$I = b_1P_1 + b_2P_2 + \ldots\ldots b_nP_m$$

Using this function, the selection criterion or the index value for each individual was determined and the varieties were ranked accordingly.

RESULTS

RESULTS

The results of the experiment are presented below:

A. Evaluation of the base material

The seedling progeny raised from open pollinated seeds obtained from closely planted mutant clones namely MC-2, MC-14, MC-16 and MC-23, parental clone FR-600 and the control, Makueni were evaluated for fodder yield and adaptability. The top ranking ten clumps from each of the six clones were identified by multivariate analysis utilizing the observations recorded on the characters, green fodder yield/clump, tiller count/clump, dry matter yield/clump and root length/clump (Table 2).

B. Clonal progeny analysis

I. Variability analysis

The data collected on green and dry matter yield, tiller count, inflorescence count, height of grasses, leaf/stem ratio, leaf area, root length, proline content and the reaction to collar rot were subjected to analysis of variance for testing the significance of the differences among the families and their progenies and ANOVA is presented in Tables 3 to 13.

Table 2. Performance of selected progenies in different families

Family	Progeny	Performance index (Pi)
FR-600	1	1.3633
	2	1.3812
	3	1.4104
	4	1.5175
	5	1.5849
	6	1.8275
	7	1.9341
	8	1.5589
	9	1.5943
	10	1.5927
Makueni	1	1.6001
	2	1.3479
	3	1.3841
	4	1.3030
	5	1.4446
	6	1.3285
	7	1.7310
	8	1.3449
	9	1.4489
	10	1.3635

Table 2 (Contd.)

Family	Progeny	Performance index (Pi)
MC-2	1	2.4766
	2	2.5715
	3	2.4695
	4	2.6106
	5	2.4615
	6	2.4659
	7	2.9170
	8	2.4764
	9	2.4783
	10	2.4616
MC-14	1	1.8890
	2	2.2590
	3	2.2388
	4	1.8182
	5	2.0429
	6	1.7292
	7	1.7833
	8	1.7183
	9	1.7803
	10	1.7661

Table 2 (Contd.)

Family	Progeny	Performance index (Pi)
MC-16	1	1.6395
	2	1.3619
	3	1.3458
	4	1.9856
	5	1.4618
	6	1.5093
	7	1.5127
	8	1.5667
	9	1.4503
	10	1.4193
MC-23	1	1.8033
	2	2.0376
	3	1.7160
	4	1.7448
	5	1.8485
	6	2.0211
	7	1.6315
	8	1.6409
	9	1.7603
	10	2.0010

The six families of guinea grass studied, exhibited significant differences for the characters viz., height of grasses, tiller count, leaf/stem ratio, leaf area, root length, proline content and inflorescence count. Reaction to collar rot, green fodder yield and dry matter yield did not exhibit any significant difference among families (Table 3). The mean values recorded for the 60 progenies with respect to ten characters are presented in Tables 4 to 13.

1. Height of grasses

The results are presented in Tables 3 and 4. Significant differences existed among the families (FR-600, Makueni, MC-2, MC-14, MC-16 and MC-23) with respect to this character. MC-23 was found to be significantly superior to MC-16, MC-2 and FR-600 and on par with Makueni and MC-14. The mean values for this trait ranged from 86.50 cm. (FR-600) to 99.44 cm. (MC-23).

Significant differences in height were noted among the progenies of FR-600, Makueni, MC-2 and MC-16. The mean values ranged from 77.08 cm. (progeny 3) to 96.61 cm. (progeny 4) in FR-600, 95.17 cm. (progeny 4) to 105.14 cm. (progeny 8) in Makueni and 82.02 cm. (progeny 9) to 95.94 cm. (progeny 8) in MC-2.

Table 3. Analysis of variance of ten characters for the six families

Sl. No.	Character	Mean square			F value
		Replication df = 3	Family df = 5	Error df = 15	
1.	Height of grasses	1636.25	1391.70	93.73	14.85**
2.	Tiller counts	2.84	33.58	9.88	3.40*
3.	Leaf/stem ratio	4.28	1.86	0.30	6.18**
4.	Leaf area	516.52	1536.29	169.38	9.07**
5.	Root length	467.51	570.51	38.30	14.90**
6.	Proline content	5.35	6440.30	5.99	1075.62**
7.	Inflorescence counts	2.44	16.69	1.13	14.76**
8.	Reaction to collar rot	1.54	6.62	8.03	0.83
9.	Green fodder yield	25642.67	340908.80	253898.70	1.34
10.	Dry matter yield	2632.00	36412.80	17606.93	2.07

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 4. Mean height of grasses (cm.)

milies	Progenies										Mean	CD values (0.05)	F values (9,27)
	1	2	3	4	5	6	7	8	9	10			
-600	88.10	87.06	77.08	96.61	92.61	91.29	81.96	81.08	88.19	81.07	86.50	6.00	8.75**
kueni	96.94	98.33	98.96	95.17	102.78	97.05	97.42	105.14	101.27	100.13	99.32	5.32	2.74*
-2	88.73	87.63	86.70	87.97	82.18	84.31	89.95	95.94	82.02	86.63	87.21	7.27	2.62*
-14	94.47	92.08	93.68	98.78	96.43	98.26	97.86	97.73	94.32	100.29	96.39	7.36	1.07
-16	91.18	89.80	96.03	90.11	89.21	95.11	93.04	90.04	90.09	81.62	90.62	6.94	2.85*
-23	98.38	100.99	99.99	99.28	103.90	102.96	98.49	100.10	94.88	95.46	99.44	7.38	1.28

CD (Between any 2 families) = 4.613

* Significant at 5 per cent level

** Significant at 1 per cent level

In MC-16, the mean value was highest for progeny 3 (96.03 cm.) which was on par with all other progenies except progeny 10 which had the lowest mean value (81.62 cm.).

2. Tiller count

Significant variation was found to exist among the families with respect to this character (Table 3). MC-2 was found to be significantly superior to all the other families. FR-600 was found to be on par with MC-16, MC-14, and Makueni and the latter was on par with MC-23. The highest mean value for this trait was recorded for MC-2 (14.75) and the lowest for MC-23 (12.16) (Table 5).

Significant differences were observed among the progenies only in MC-23. The highest mean value was recorded by progeny 3 (14.20) and the lowest by progeny 10 (9.18) (Table 5).

3. Leaf/stem ratio

Significant differences were observed among the families (Table 3). Makueni which had the highest mean value of 2.36 was found to be significantly superior to MC-2 and FR-600 but found to be on par with MC-14, MC-16 and MC-23. The lowest mean value of 1.81 was recorded by FR-600 (Table 6).

Table 5. Mean tiller count

ilies	Progenies										Mean	CD values (0.05)	F values (9,27)
	1	2	3	4	5	6	7	8	9	10			
600	13.39	12.28	10.65	17.19	15.53	14.99	14.76	15.53	15.14	11.85	14.13	4.37	1.80
ueni	11.79	13.74	13.58	10.64	14.29	10.98	12.43	13.76	15.43	12.68	12.93	3.33	1.73
2	14.73	18.64	14.11	14.28	15.80	15.06	14.19	12.96	13.10	14.60	14.75	3.97	1.37
14	12.63	12.63	15.79	13.99	12.10	12.53	13.96	14.48	13.33	15.28	13.67	3.47	1.09
16	12.50	14.90	13.16	11.75	13.63	15.14	17.23	12.06	14.90	13.29	13.86	4.34	1.27
23	13.71	10.70	14.20	12.75	13.39	12.89	13.10	11.33	10.32	9.18	12.16	3.14	2.37*

CD (Between any 2 families) = 1.498

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 6. Mean leaf/stem ratio

ilies	Progenies										Mean	CD values (0.05)	F values (9,27)
	1	2	3	4	5	6	7	8	9	10			
-600	1.90	1.94	1.47	2.37	1.94	1.71	1.87	2.14	1.58	1.19	1.81	0.69	2.04
kueni	2.13	2.61	1.80	2.57	2.40	2.15	2.44	2.69	2.51	2.26	2.36	0.97	0.66
-2	2.05	1.74	1.88	1.54	2.03	2.15	1.59	2.07	2.05	1.86	1.90	0.75	0.67
-14	2.14	2.25	2.56	1.77	2.44	2.32	2.42	2.15	2.12	2.67	2.28	0.91	0.67
-16	2.11	2.39	2.80	2.05	2.10	1.96	2.00	1.99	1.54	2.66	2.16	1.13	0.88
-23	2.46	2.32	2.24	2.12	1.94	1.98	2.21	2.07	2.04	2.32	2.17	0.45	1.15

CD (Between any 2 families) = 0.261

* Significant at 5 per cent level

** Significant at 1 per cent level

Pooled analysis of the families showed that there were no significant differences among the progenies in any of the families (Table 6).

4. Leaf area

The results are presented in Tables 3 and 7. Significant differences were found to exist among the families with respect to this trait. MC-23 which recorded the highest mean value was on par with MC-14 and Makueni but was significantly superior to FR-600, MC-2 and MC-16. Makueni was found to be on par with MC-16. The mean values for this trait ranged from 47.62 cm^2 (FR-600) to 61.83 cm^2 (MC-23).

Significant differences among the progenies were observed in FR-600, MC-2 and MC-16.

The mean values ranged from 34.47 cm^2 (progeny 3) to 56.41 cm^2 (progeny 6) in FR-600, 42.54 cm^2 (progeny 9) to 60.96 cm^2 (progeny 8) in MC-2 and 43.72 cm^2 (progeny 10) to 56.89 cm^2 (progeny 9) in MC-16.

5. Root length

Significant differences existed among the families (Table 3). MC-14 was found to be significantly superior to MC-16, FR-600 and MC-2 but was found to be on par with Makueni and MC-23. The highest mean value was recorded by

Table 7. Mean leaf area (cm^2)

Progenies 1	2	3	4	5	6	7	8	9	10	Mean	CD values (0.05)	F values (9,27)
50.00	52.95	34.47	52.39	50.06	56.41	44.31	45.91	44.39	45.33	47.62	11.69	2.34*
50.97	52.66	54.94	57.46	58.06	57.18	58.08	59.70	63.40	61.26	57.37	11.83	0.85
45.36	50.37	43.06	51.09	43.42	46.39	49.90	60.96	42.54	52.06	48.51	10.39	2.47*
58.69	55.23	60.74	63.07	59.95	58.77	64.83	65.75	58.48	63.69	60.92	9.26	1.09
46.96	53.33	53.64	54.69	55.89	52.54	53.06	46.81	59.90	43.72	52.05	7.75	3.29**
68.19	61.41	64.96	61.41	58.11	66.59	56.13	62.85	56.50	62.14	61.83	15.18	0.61

CD (Between any 2 families) = 6.201

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 8. Mean root length (cm.)

Families	Progenies										Mean	CD values (0.05)	F values (9,27)
	1	2	3	4	5	6	7	8	9	10			
FR-600	31.80	35.00	24.18	32.58	32.23	32.53	28.38	30.48	32.20	29.18	31.25	6.79	2.08
Makueni	35.58	36.98	37.75	37.30	41.70	34.68	35.25	37.13	41.03	41.00	37.84	7.58	0.95
MC-2	29.90	30.35	28.73	30.43	34.08	28.60	28.45	35.35	30.58	27.90	30.44	6.40	1.24
MC-14	39.80	36.38	42.10	38.35	38.20	39.48	38.58	41.73	34.70	39.60	38.89	8.08	0.64
MC-16	35.80	32.75	33.90	33.15	32.50	29.38	30.00	29.63	28.33	26.80	31.22	6.89	1.41
MC-23	35.30	39.63	35.40	38.28	36.70	38.93	34.73	36.18	35.30	32.68	36.31	7.23	0.72

CD (Between any 2 families) = 2.949

* Significant at 5 per cent level

** Significant at 1 per cent level

MC-14 (38.89 cm.) and the lowest by MC-2 (30.44 cm.) (Table 8).

There were no significant differences among the progenies in any of the families (Table 8).

6. Proline content

The results presented in Table 3 indicated that there was significant difference in the free proline content among the six families. The mean values ranged from 38.44 μg./g. (Makueni) to 69.69 μg./g. (MC-14). MC-14 was found to be significantly superior to all other families. FR-600 and Makueni were found to be on par (Table 9).

Significant differences among the progenies were found to exist within all the families (Table 9).

The mean values ranged from 21.30 μg./g. (progeny 9) to 67.25 μg./g. (progeny 7), in FR-600, 22.20 μg./g. (progeny 7) to 55.50 μg./g. (progeny 6) in Makueni, 31.34 μg./g. (progeny 3) to 69.43 μg./g. (progeny 10) in MC-2, 53.24 μg./g. (progeny 8) to 101.19 μg./g. (progeny 6) in MC-14, 32.26 μg./g. (progeny 8) to 98.38 μg./g. (progeny 7) in MC-16 and 23.42 μg./g. (progeny 3) to 71.79 μg./g. (progeny 7) in MC-23.

7. Inflorescence count

The results are presented in Tables 3 and 10.

Table 9. Mean proline content (µg./g.)

Families	Progenies 1	2	3	4	5	6	7	8	9	10	Mean	CD values (0.05)	F values (9,27)
FR-600	54.32	44.35	38.41	56.28	34.32	25.33	67.25	26.51	21.30	26.34	39.44	2.80	262.13**
Makueni	30.40	45.27	46.36	31.28	31.33	55.50	22.20	36.27	52.32	33.50	38.44	2.69	136.57**
MC-2	57.16	43.29	31.34	60.26	33.24	57.33	60.11	64.31	66.20	69.43	54.27	3.13	157.28**
MC-14	56.36	61.05	53.59	58.46	74.29	101.19	81.39	53.24	80.38	76.92	69.69	4.15	121.09**
MC-16	93.34	89.71	33.45	38.45	67.20	51.34	98.38	35.26	69.35	47.17	62.06	4.36	282.74**
MC-23	39.26	37.49	23.42	25.62	56.28	52.43	71.79	60.54	41.31	44.41	45.26	5.00	78.17**

CD (Between any 2 families) = 1.166

* Significant at 5 per cent level

** Significant at 1 per cent level

Table 10. Mean inflorescence count

'amilies	Progenies										Mean	CD values (0.05)	F values (9,27)
	1	2	3	4	5	6	7	8	9	10			
'R-600	0.00	2.13	2.44	0.81	1.63	0.13	3.25	3.56	3.25	2.69	1.99	1.77	4.56**
akueni	0.19	0.44	0.31	0.38	0.56	0.44	0.56	1.00	0.13	0.56	0.46	0.50	2.02
C-2	1.75	2.00	1.56	2.69	1.50	1.00	1.25	0.50	0.69	1.31	1.42	1.19	2.45*
C-14	0.06	0.25	0.94	0.81	0.13	0.38	0.56	0.50	0.06	0.25	0.39	0.58	2.39*
C-16	0.19	0.19	0.31	1.12	0.00	0.44	1.50	0.56	0.38	0.13	0.48	0.80	2.99*
C-23	1.00	1.06	0.94	0.63	0.94	1.00	0.81	0.69	0.44	0.81	0.83	0.81	0.50

CD (Between any 2 families) = 0.507

* Significant at 5 per cent level

** Significant at 1 per cent level

Significant differences were observed among the families for this character. FR-600 was found to be significantly superior to all the other families. The families Makueni, MC-14, MC-16 and MC-23 were on par with respect to this character. The mean values ranged from 0.39 in MC-14 to 1.99 in FR-600.

Significant differences among the progenies were recorded in FR-600, MC-2, MC-14 and MC-16.

The mean values ranged from 0.00 (progeny 1) to 3.56 (progeny 8) in FR-600, 0.50 (progeny 8) to 2.69 (progeny 4) in MC-2 and 0.06 (progenies 1 and 9) to 0.94 (progeny 3) in MC-14. In MC-16 the progeny 7 which gave the highest mean value of 1.50 was on par with progeny 4. The lowest mean value (0.00) was recorded by progeny 5.

8. Reaction to collar rot

Analysis of variance revealed that there were no significant differences among the families with respect to their reaction to the disease, collar rot (Table 3).

However progeny differences existed in MC-2, in which the mean values ranged from 0.00 in progeny 10 to 3.00 in progeny 4 (Table 11).

9. Green fodder yield

The results are represented in Tables 3 and 12 and by the figures 1 to 7.

Table 11. Mean reaction to collar rot

ies	Progenies										Mean	CD values (0.05)	F values (9,27)
	1	2	3	4	5	6	7	8	9	10			
00	1.00	0.75	0.75	0.75	1.25	1.75	0.50	1.25	1.50	1.00	1.05	1.77	0.40
eni	0.00	1.00	1.50	0.75	0.25	0.50	0.75	2.00	1.50	2.50	1.08	2.00	1.32
	0.50	2.50	2.25	3.00	2.50	1.00	0.75	2.25	0.50	0.00	1.53	1.81	2.98*
4	1.75	3.25	2.25	1.25	1.50	0.75	0.00	3.00	4.00	0.25	1.80	2.70	2.01
5	1.00	0.50	0.25	0.00	1.25	0.75	0.50	1.75	2.00	2.25	1.05	1.77	1.46
3	0.75	1.00	1.00	1.00	1.00	0.75	1.25	0.75	0.00	0.00	0.65	1.04	1.75

CD (Between any 2 families) = 1.350

* Significant at 5 per cent level

** Significant at 1 per cent level

Analysis of variance revealed that the families did not differ significantly with respect to this trait. The mean values ranged from 1352.71 g. for MC-16 to 1570.31 g. for MC-23.

However, when these families were analysed separately significant differences were found among the progenies of the families FR-600, MC-2, MC-16 and MC-23.

In FR-600, the fourth progeny having a mean value of 2019.50 g. was superior to all others except the 5th, 9th and 6th progenies with which it was on par. The lowest mean value was recorded by the 3rd progeny (906.00 g.).

The mean values ranged from 981.00 g. (progeny 9) to 1824.50 g. (progeny 8) in MC-2, 1070.75 g. (progeny 10) to 1986.88 g. (progeny 7) in MC-16 and 1018.38 g. (progeny 10) to 2041.75 g. (progeny 4) in MC-23.

10. Dry matter yield

The results are presented in Tables 3 and 13. There were no significant differences among the families with respect to this character. The mean values ranged from 374.94 g. (MC-2) to 449.34 g. (Makueni).

However, significant differences were observed among the progenies in FR-600, Makueni, MC-2, MC-16 and MC-23.

Table 12. Mean fodder yield (g.)

ies	Progenies 1	2	3	4	5	6	7	8	9	10	Mean	CD values (0.05)	F values (9,27)
o	1292.75	1234.50	906.00	2019.50	1729.13	1577.50	1218.50	1377.00	1483.13	1244.88	1408.29	560.23	2.59*
ni	1264.38	1759.75	1518.00	1199.63	1778.88	1182.70	1449.13	1677.38	1756.63	1544.50	1513.10	470.31	2.08
	1347.50	1593.63	1265.50	1367.75	1277.00	1200.50	1454.25	1824.50	981.00	1521.13	1383.28	372.01	3.28**
	1333.13	1503.50	1662.50	1460.50	1342.75	1524.13	1683.75	1748.50	1474.75	1737.88	1547.14	367.23	1.47
	1228.63	1378.75	1284.13	1080.75	1305.38	1674.13	1986.88	1079.75	1438.00	1070.75	1352.71	430.89	3.85**
	1549.63	1573.25	1740.00	2041.75	1682.50	1604.88	1558.20	1636.13	1298.38	1018.38	1570.31	471.75	2.73*

CD (Between any 2 families) = 240.104

* Significant at 5 per cent level

** Significant at 1 per cent level

FIG.1. HISTOGRAM SHOWING MEAN YIELD IN SIX FAMILIES OF GUINEA GRASS.

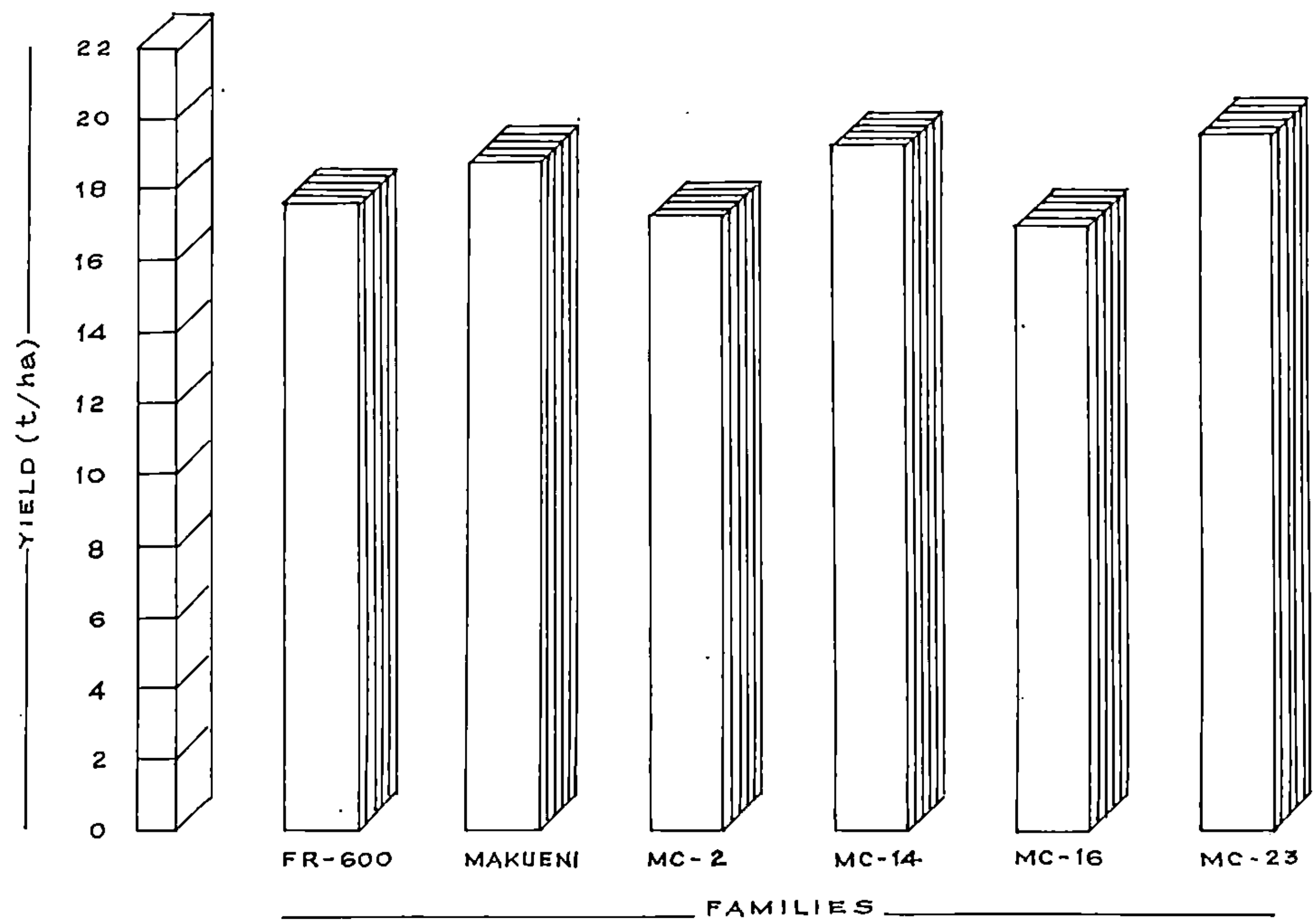

FIG. 2. HISTOGRAM SHOWING MEAN YIELD IN 10 PROGENIES OF FR-600.

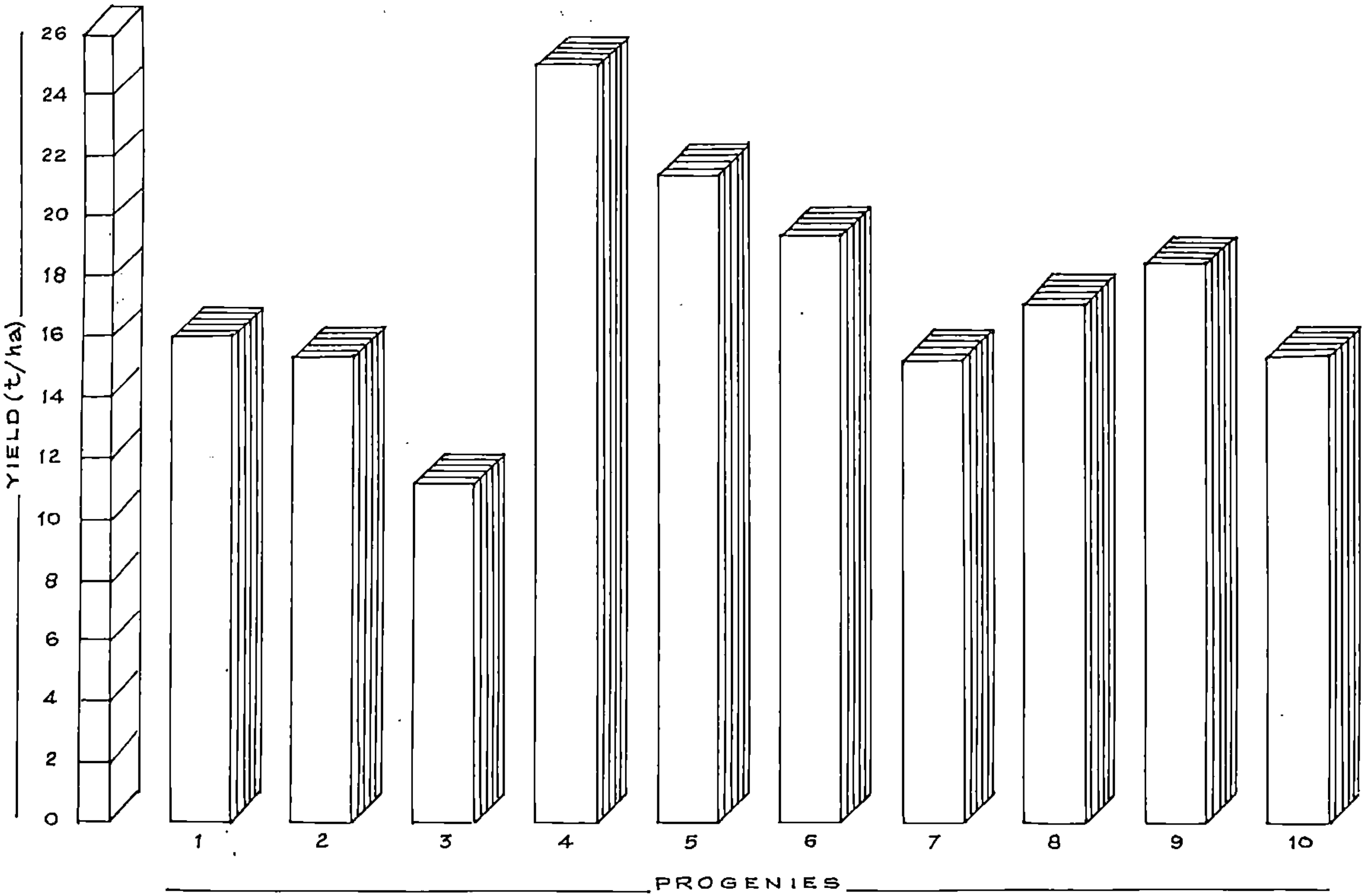

FIG. 3. HISTOGRAM SHOWING MEAN YIELD IN 10 PROGENIES OF MAKUENI.

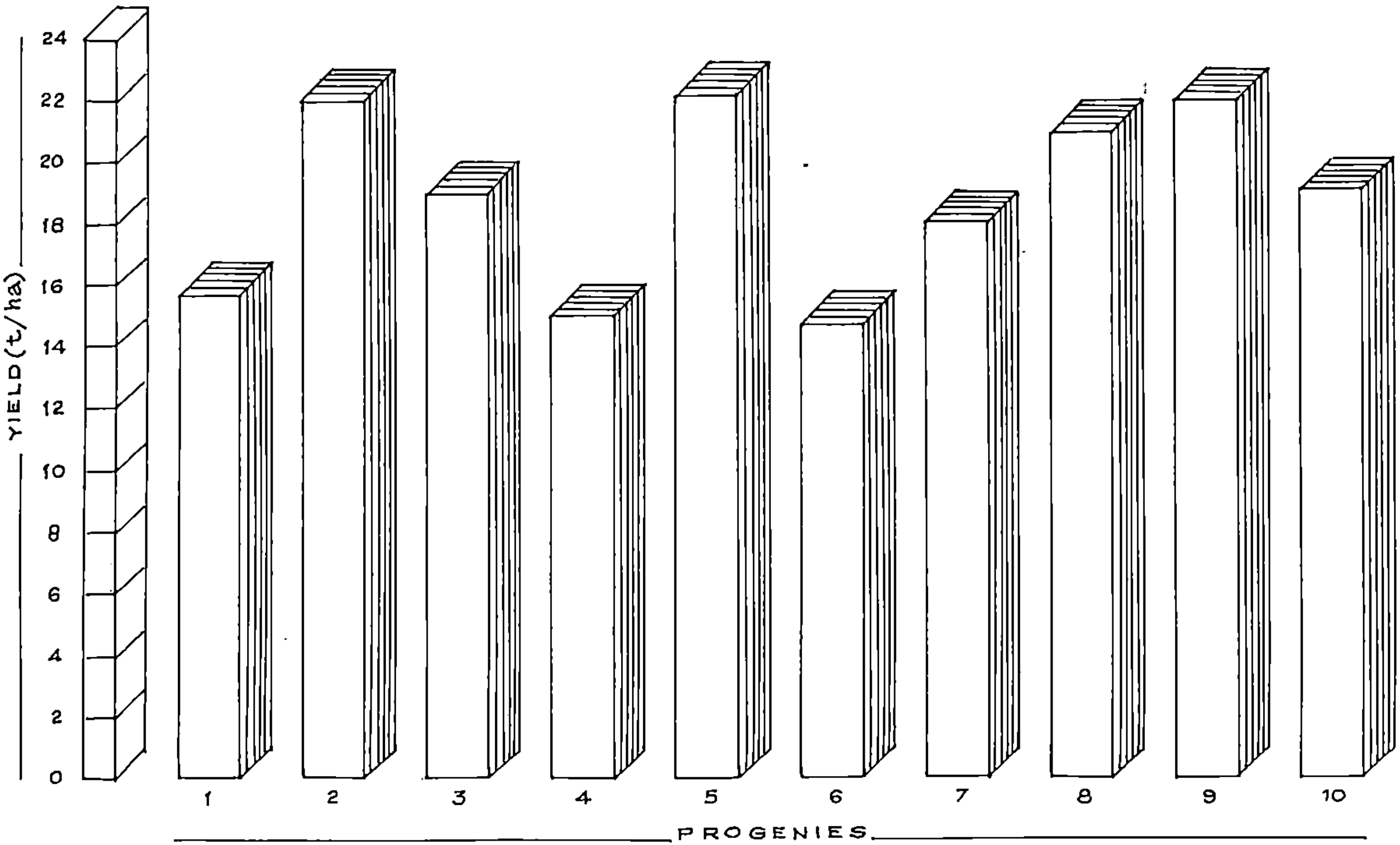

FIG. 4. HISTOGRAM SHOWING MEAN YIELD IN 10 PROGENIES OF MC-2.

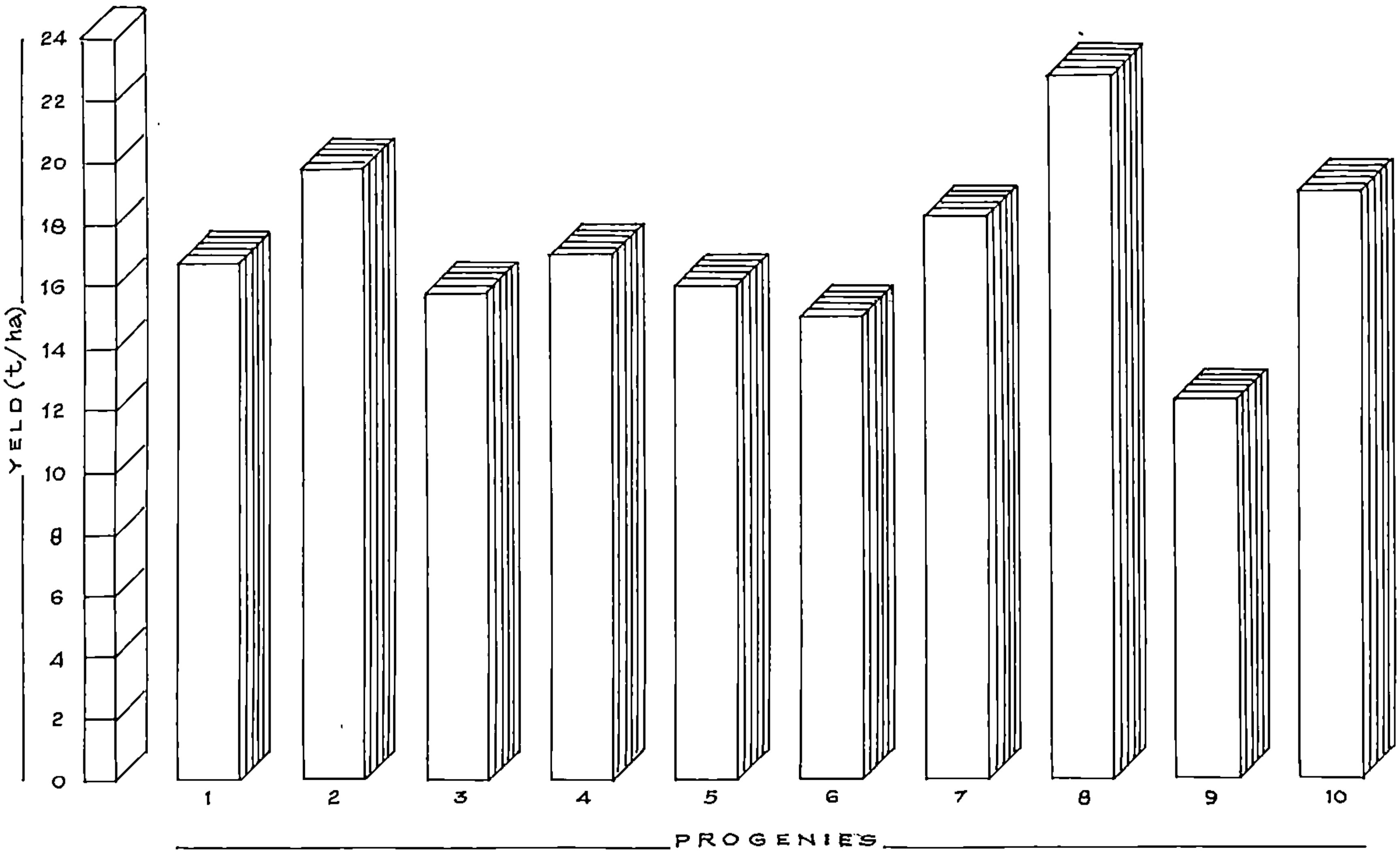

FIG. 5. HISTOGRAM SHOWING MEAN YIELD IN 10 PROGENIES OF MC-14.

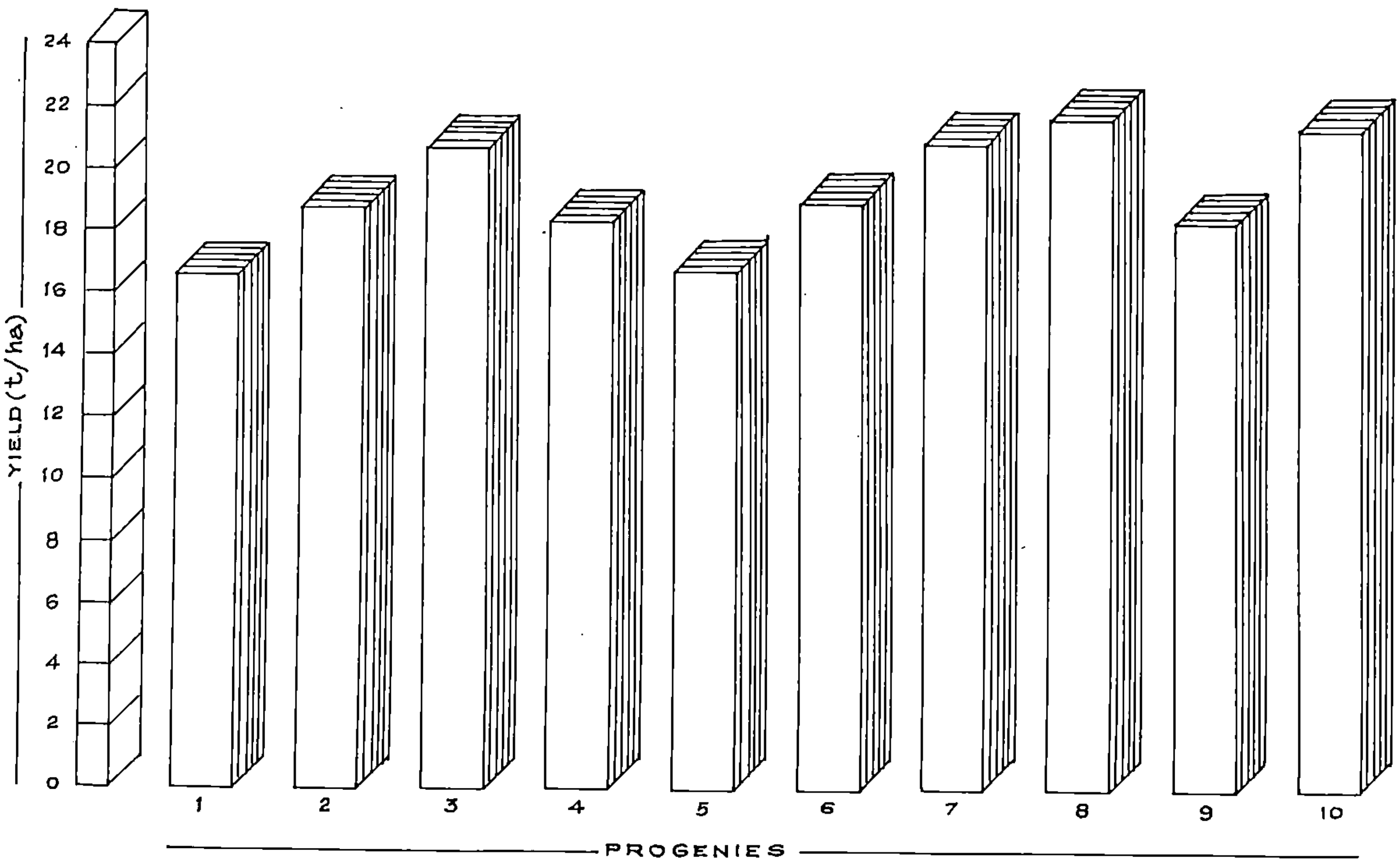

FIG. 6. HISTOGRAM SHOWING MEAN YIELD IN 10 PROGENIES OF MC-16.

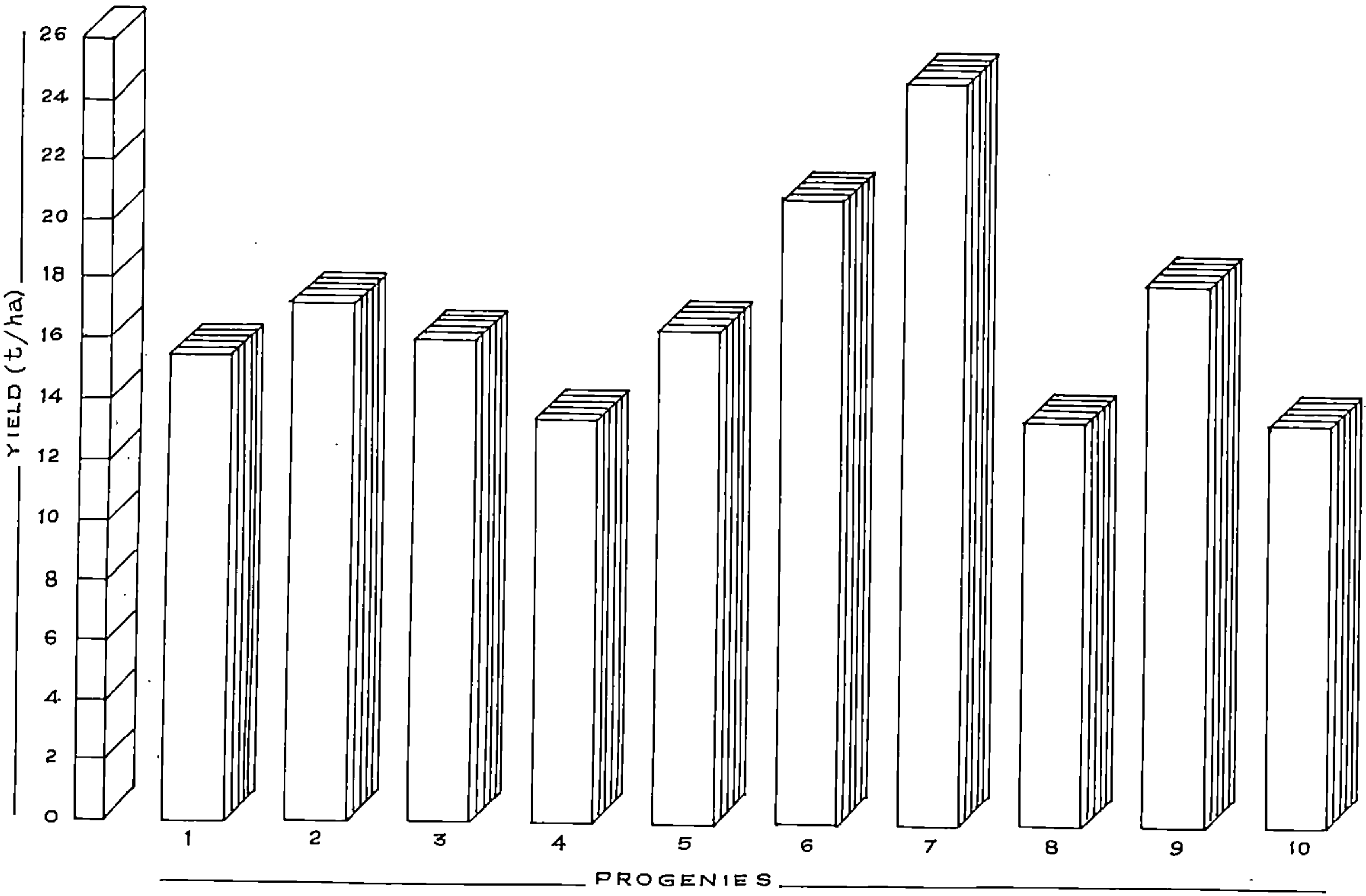

FIG. 7. HISTOGRAM SHOWING MEAN YIELD IN 10 PROGENIES OF MC-23.

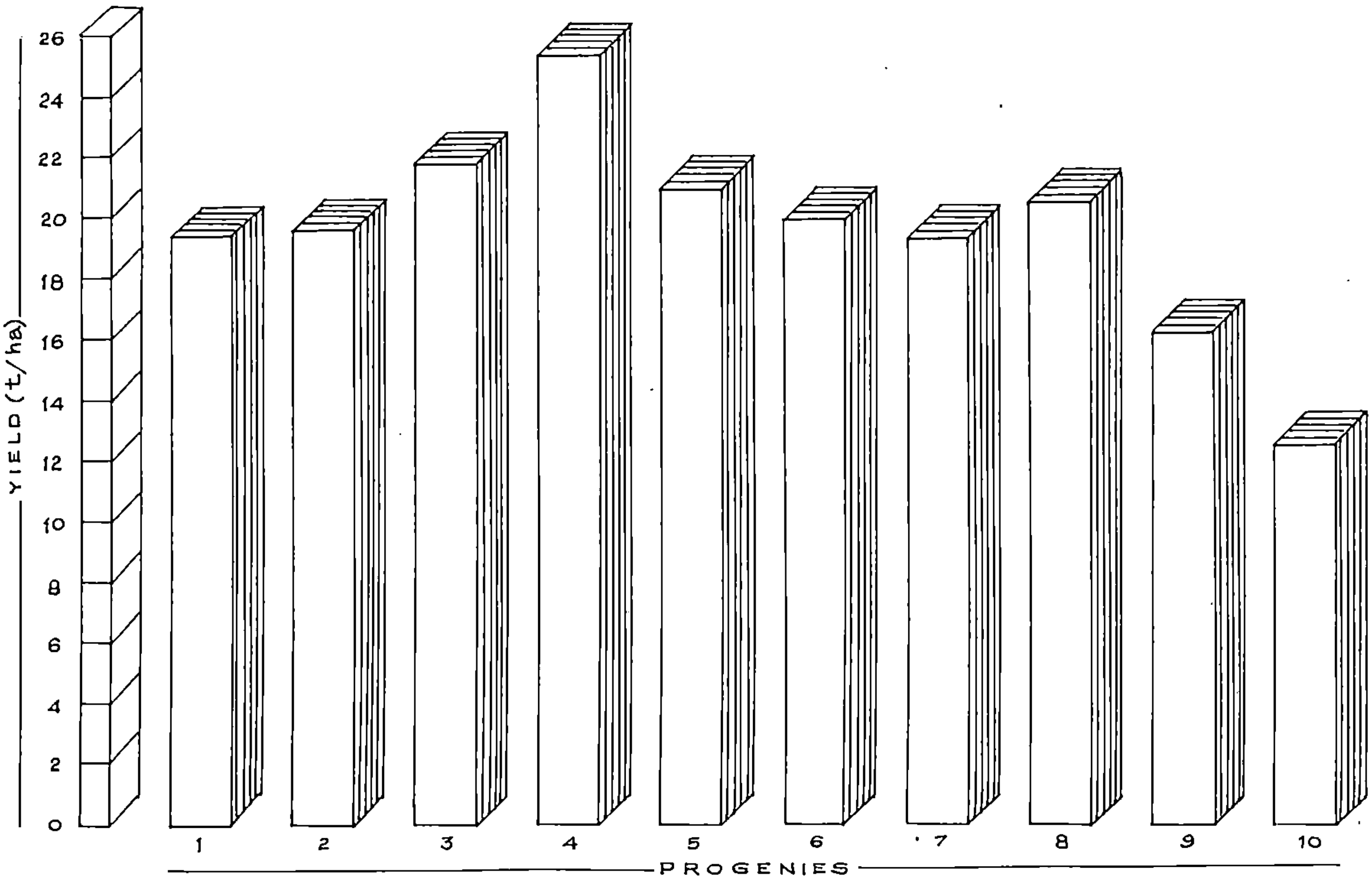

Table 13. Mean dry matter yield (g.)

Families	Progenies										Mean	CD values (0.05)	F values (9,27)
	1	2	3	4	5	6	7	8	9	10			
FR-600	365.15	384.58	282.48	567.03	518.00	467.28	399.78	425.90	421.25	358.03	418.95	153.30	2.43*
Makueni	379.80	505.98	447.00	340.33	503.83	343.85	453.78	503.15	536.98	478.73	449.34	128.65	2.57*
MC-2	381.93	433.15	316.63	344.10	361.28	341.60	333.83	505.08	276.00	455.78	374.94	102.40	403.93**
MC-14	348.38	407.40	480.45	403.28	380.80	427.65	471.73	437.33	414.88	511.08	428.30	104.26	1.84
MC-16	323.78	394.73	399.63	303.80	358.43	448.65	549.70	277.33	429.15	303.15	378.83	120.50	4.02**
MC-23	436.38	378.85	499.90	562.50	470.78	421.80	418.18	473.13	324.60	330.35	431.65	125.38	2.97*

CD (Between any 2 families) = 63.228

* Significant at 5 per cent level

** Significant at 1 per cent level

The mean values ranged from 282.48 g. (progeny 3) to 567.03 g. (progeny 4) in FR-600, 340.33 g. (progeny 4) to 536.98 g. (progeny 9) in Makueni, 276 g. (progeny 9) to 505.08 g. (progeny 8) in MC-2, 277.33 g. (progeny 8) to 549.70 g. (progeny 7) in MC-16 and 324.6 g. (progeny 9) to 562.5 g. (progeny 4) in MC-23.

11. Soil moisture analysis

The data on the mean soil moisture percentages measured during the peak summer months are presented in Table 14.

The analysis of variance of the soil moisture percentages measured from the experimental plots during the peak summer months did not show any significant difference, indicating that uniform moisture conditions prevailed in the experimental plots (Table 15).

II. Genetic parameters

Phenotypic and genotypic variances and the coefficients of variation relating to the six families are presented in Table 16.

When the families were analysed separately genetic differences existed in FR-600 for the traits height of grasses, leaf area, free proline content of leaves, inflorescence count, green fodder yield and dry matter yield.

Table 14. Mean values of soil moisture percentage

Sl. No.	Varieties	January	February	March	April
1.	FR-600	3.86	3.28	3.32	5.10
2.	Makueni	3.91	3.43	3.46	5.04
3.	MC-2	3.82	3.15	3.21	5.26
4.	MC-14	3.81	3.34	3.64	5.37
5.	MC-16	3.96	3.08	3.45	5.12
6.	MC-23	3.64	3.04	3.36	5.41

Table 15. Analysis of variance for soil moisture percentage

Month	Mean square			F value
	Replication df = 3	Treatment df = 5	Error df = 15	
January	0.23	0.05	0.14	0.36
February	0.18	0.09	0.14	0.67
March	0.32	0.09	0.14	0.60
April	0.31	0.09	0.23	0.40

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e 16. Phenotypic and genotypic variances, mean and phenotypic and genotypic coefficients of variation for the six families of guinea grass

Characters	Phenotypic variance	Genotypic variance	Mean $\bar{x}$	Phenotypic coefficient of variation	Genotypic coefficient of variation
. Height of grasses	418.23	324.49	93.25	21.93	19.32
. Tiller count	15.81	5.93	13.58	29.27	17.92
. Leaf/stem ratio	0.69	0.39	2.11	39.33	29.54
. Leaf area	511.11	341.73	54.72	41.32	33.78
. Root length	171.35	133.05	34.32	38.14	33.61
. Proline content	1614.57	1608.58	51.52	77.99	77.84
. Inflorescence count	5.02	3.89	0.93	241.16	212.27
3. Reaction to collar rot	7.68	N.E.	1.19	235.53	N.E.
9. Green fodder yield	275651.23	21752.53	1462.47	35.90	10.08
0. Dry matter yield	22308.40	4701.47	413.67	36.11	16.58

In Makueni, the traits height of grasses, free proline content of leaves and dry matter yield exhibited genetic differences among the progenies. In MC-2, the progenies had genetic differences for height of grasses, leaf area, free proline content of leaves, inflorescence count, reaction to collar rot, green fodder and dry matter yield. The characters inflorescence count and free proline content of leaves showed genetic differences among the progenies in MC-14, while in MC-16 genetic differences among the progenies existed for height of grasses, leaf area, inflorescence count, proline content of leaves, green fodder and dry matter yield. In MC-23, genetic differences among the progenies were observed with respect to the characters tiller count, free proline content of leaves, green fodder and dry matter yield (Table 17).

Phenotypic variance, genotypic variance and the coefficients of variation were worked out for the families which had significant differences among their progenies and are presented in Tables 17 and 18. The phenotypic variance, genotypic variance, and the coefficients of variation for the 60 progenies studied are presented in Table 19.

1. Phenotypic coefficient of variation

The phenotypic coefficient of variation (PCV) was

Table 17. Phenotypic variance and genotypic variance for the progenies within each family

Characters	FR-600		Makueni		MC-2		MC-14		MC-16		MC-23	
	$\sigma p^2(x)$	$\sigma g^2(x)$	$\sigma p^2(x)$	$\sigma g^2(x)$	$\sigma p^2(x)$	$\sigma g^2(x)$	$\sigma p^2(x)$	$\sigma g^2(x)$	$\sigma p^2(x)$	$\sigma g^2(x)$	$\sigma p^2(x)$	$\sigma g^2(x)$
Height of grasses	50.20	33.11	19.32	5.87	35.30	10.17	-	-	32.72	9.84	-	-
Tiller count	-	-	-	-	-	-	-	-	-	-	6.28	1.60
Leaf/stem ratio	-	-	-	-	-	-	-	-	-	-	-	-
Leaf area	86.72	21.82	-	-	70.17	18.88	-	-	44.93	16.37	-	-
Root length	-	-	-	-	-	-	-	-	-	-	-	-
Proline content	246.82	243.10	119.57	116.14	186.73	182.07	253.34	245.18	644.85	635.82	240.60	228.74
Inflorescence count	2.82	1.33	-	-	0.91	0.24	0.21	0.05	0.45	0.15	-	-
Reaction to collar rot	-	-	-	-	2.33	0.77	-	-	-	-	-	-
Green fodder yield	208506.20	59430.97	-	-	103174.70	37443.11	-	-	151000.90	62813.04	151314.00	45610.00
Dry matter yield	15139.45	3976.83	10950.47	3088.86	8627.99	3647.88	-	-	12105.17	5208.85	11138.18	3671.09

Table 18. Phenotypic and genotypic coefficients of variation for the progenies within each family

Sl. No.	Characters	FR-600		Makueni		MC-2		MC-14		MC-16		MC-23	
		PCV	GCV	PCV	GCV	PCV	GCV	PCV	GCV	PCV	GCV	PCV	GCV
1.	Height of grasses	8.19	6.65	4.43	2.44	6.81	3.66	-	-	6.31	3.46	-	-
2.	Tiller count	-	-	-	-	-	-	-	-	-	-	22.62	10.42
3.	Leaf/stem ratio	-	-	-	-	-	-	-	-	-	-	-	-
4.	Leaf area	19.55	9.81	-	-	17.27	8.96	-	-	12.88	7.77	-	-
5.	Root length	-	-	-	-	-	-	-	-	-	-	-	-
6.	Proline content	39.83	39.53	28.45	28.04	25.18	24.86	22.84	22.47	40.92	40.63	34.28	33.42
7.	Inflorescence count	84.47	57.98	-	-	66.92	34.51	116.76	59.26	139.87	80.55	-	-
8.	Reaction to collar rot	-	-	-	-	99.99	57.55	-	-	-	-	-	-
9.	Green fodder yield	32.42	17.31	-	-	23.22	13.99	-	-	28.73	18.53	24.77	13.60
10.	Dry matter yield	29.37	15.05	23.29	12.36	24.77	16.11	-	-	29.04	19.05	24.45	14.04

Table 19. Phenotypic and genotypic variances, mean and phenotypic and genotypic coefficients of variation for the sixty progenies

Sl. No.	Characters	Phenotypic variance	Genotypic variance	Mean $\bar{x}$	Phenotypic coefficient of variation	Genotypic coefficient of variation
1.	Height of grasses	64.64	36.84	93.25	8.62	6.51
2.	Tiller count	8.51	1.39	13.58	21.48	8.67
3.	Leaf/stem ratio	0.36	0.03	2.11	28.47	7.61
4.	Leaf area	105.26	35.78	54.72	18.75	10.93
5.	Root length	37.64	11.97	34.32	17.87	10.08
6.	Proline content	394.92	388.18	51.52	38.57	38.24
7.	Inflorescence count	1.16	0.60	0.93	115.93	83.29
8.	Reaction to collar rot	2.52	0.25	1.19	133.20	42.10
9.	Green fodder yield	148298.05	38639.45	1462.47	26.33	13.44
10.	Dry matter yield	11685.88	3553.36	413.67	26.13	14.41

in general, high for all the characters as compared to the genotypic coefficient of variation (GCV).

For the 60 progenies studied, reaction to collar rot recorded the highest value (133.20%) followed by inflorescence count (115.93%). The lowest value was recorded for the character height of grasses (8.62%).

2. Genotypic coefficient of variation

For the 60 progenies studied, high GCV values exceeding 30 per cent were recorded for inflorescence count (83.30%), reaction to collar rot (42.10%) and free proline content of leaves (38.23%). All the other characters recorded GCV values less than 15 per cent viz., dry matter yield (14.41%), green fodder yield (13.44%), leaf area (10.93%), root length (10.08%), tiller count (8.67%), leaf/stem ratio (7.61%) and height of grasses (6.51%).

3. Heritability in the broad sense

The results are presented in Tables 20, 21 and 22.

In the 60 progenies studied, high values of heritability were recorded for the characters, free proline content of leaves (98.29%), height of grasses (57.00%) and inflorescence count (51.62%). Moderate heritability values were observed for leaf area (33.99%), root length (31.80%) and dry matter yield (30.41%). Green fodder yield (26.06%),

Table 20. Heritability and expected genetic advance for the six families of guinea grass

Sl. No.	Characters	Heritability percentage (H^2)	Expected genetic advance as percentage of mean
1.	Height of grasses	77.59	35.05
2.	Tiller count	37.49	22.61
3.	Leaf/stem ratio	56.43	45.72
4.	Leaf area	66.86	56.91
5.	Root length	77.65	61.00
6.	Proline content	99.63	160.05
7.	Inflorescence count	77.48	384.91
8.	Reaction to collar rot	N.E.	N.E.
9.	Green fodder yield	7.89	5.84
10.	Dry matter yield	21.07	15.68

Table 21. Heritability and expected genetic advance for the 60 progenies

Sl. No.	Characters	Heritability percentage (H^2)	Expected genetic advance as percentage of mean
1.	Height	57.00	1012
2.	Tiller count	16.30	7.21
3.	Leaf/stem ratio	7.15	4.20
4.	Leaf area	33.99	13.13
5.	Root length	31.80	11.71
6.	Proline content	98.29	78.10
7.	Inflorescence count	51.62	123.28
8.	Reaction to collar rot	9.99	27.41
9.	Green fodder yield	26.06	14.13
10.	Dry matter yield	30.41	16.37

Table 22. Heritability and expected genetic advance for the progenies within each family

Characters	FR-600		Makueni		MC-2		MC-14		MC-16		MC-23	
	H^2	GA	H^2	GA	H^2	GA	H^2	GA	H^2	GA	H^2	GA
ght of grasses	65.97	11.13	30.37	2.77	28.83	4.11	-	-	30.09	3.91	-	-
ler count	-	-	-	-	-	-	-	-	-	-	25.53	10.84
f/stem ratio	-	-	-	-	-	-	-	-	-	-	-	-
af area	25.16	10.13	-	-	26.90	9.57	-	-	36.43	9.66	-	-
ot length	-	-	-	-	-	-	-	-	-	-	-	-
line content	98.49	80.82	99.13	56.92	97.50	50.58	96.78	45.53	98.60	83.11	95.07	66.80
lorescence nt	47.11	81.97	-	-	26.59	36.65	25.76	61.96	33.17	95.56	-	-
action to lar rot	-	-	-	-	33.13	68.25	-	-	-	-	-	-
een fodder eld	28.50	19.04	-	-	36.29	17.36	-	-	41.60	24.62	30.14	15.38
matter yield	26.27	15.89	28.21	13.53	42.28	21.84	-	-	43.03	25.74	32.96	16.60

tiller number (16.30%), reaction to collar rot (9.99%) and leaf/stem ratio (7.15%) showed low heritability.

4. Expected genetic advance

The genetic advance expressed as percentage of the mean value was computed and is presented in Tables 20, 21 and 22.

In the 60 progenies studied, inflorescence count recorded the maximum genetic advance (123.28%) followed by free proline content of leaves (78.10%) and reaction to collar rot (27.41%). Low values were observed for dry matter yield (6.37%), green fodder yield (14.13%), leaf area (13.13%), root length (11.71%), height of grasses (10.12%), tiller number (7.21%) and leaf/stem ratio (4.2%).

III. Selection index

Height, tiller number, leaf area, leaf/stem ratio and green matter yield which are the most important and easy to measure yield contributing parameters in guinea grass were selected for the formulation of a selection index. The selection index prepared by exercising ten per cent selection is presented in Table 23.

The index value for each progeny was determined and the progenies were ranked accordingly. The highest index was recorded by progeny 4 of MC-23 (4265.69) followed by

Table 23. Selection Index (score) for the sixty progenies

Sl. No.	Family	Progeny No.	Selection Index
1.	MC-23	4	4265.69
2.	Makueni	8	4035.31
3.	Makueni	5	4033.72
4.	MC-23	5	4020.09
5.	MC-23	6	3994.04
6.	MC-23	8	3992.56
7.	MC-23	2	3976.77
8.	MC-2	8	3969.20
9.	MC-23	3	3968.00
10.	Makueni	9	3952.76
11.	FR-600	4	3927.52
12.	MC-14	10	3916.54
13.	MC-14	8	3908.46
14.	Makueni	2	3889.54
15.	MC-14	7	3868.70
16.	Makueni	10	3841.18
17.	MC-16	7	3807.69
18.	MC-23	1	3790.90
19.	MC-14	6	3764.86
20.	MC-23	7	3762.64

Table 23 (Contd.)

1	2	3	4
21.	Makueni	3	3714.64
22.	MC-14	4	3685.74
23.	Makueni	7	3674.29
24.	MC-16	6	3669.52
25.	MC-14	3	3633.75
26.	FR-600	5	3621.59
27.	MC-14	9	3579.96
28.	MC-14	5	3576.66
29.	MC-14	2	3557.52
30.	MC-23	9	3556.70
31.	FR-600	6	3510.51
32.	MC-14	1	3487.90
33.	Makueni	1	3485.29
34.	Makueni	6	3484.73
35.	Makueni	4	3462.71
36.	MC-16	3	3428.11
37.	MC-23	10	3399.15
38.	MC-16	9	3377.39
39.	MC-2	7	3362.97
40.	MC-2	10	3326.58
41.	MC-16	2	3272.61
42.	FR-600	9	3269.48

Table 23 (Contd.)

1	2	3	4
43.	MC-16	5	3263.19
44.	MC-16	1	3245.35
45.	MC-2	4	3235.23
46.	MC-2	2	3233.57
47.	FR-600	1	3200.95
48.	FR-600	2	3185.36
49.	MC-2	1	3181.24
50.	MC-16	4	3160.04
51.	MC-16	8	3099.86
52.	MC-2	3	3068.44
53.	FR-600	10	3016.51
54.	FR-600	8	2970.84
55.	MC-2	6	2920.96
56.	MC-2	5	2885.04
57.	FR-600	7	2878.02
58.	MC-16	10	2790.48
59.	MC-2	9	2726.40
60.	FR-600	3	2593.47

progeny 8 of Makueni (4035.31), progeny 5 of Makueni (4033.72), progeny 5 of MC-23 (4020.09), progeny 6 of MC-23 (3994.04), progeny 8 of MC-23 (3992.56), progeny 2 of MC-23 (3976.77) etc., in that order. The top ranking six progenies with the highest scores were identified to be genetically superior from among the open pollinated seed progeny raised from the guinea grass clones viz., FR-600, Makueni, MC-2, MC-14, MC-16 and MC-23.

IV. Weather parameters

The weather parameters viz., total rainfall, mean relative humidity, mean maximum temperature and the mean minimum temperature received during each of the crop growth periods are presented in Table 24. Total rainfall was highest during the first harvest (384.21 mm) and lowest (nil) during the third harvest. The mean relative humidity was highest for the fourth harvest (94.54%) and lowest for the second harvest (69.45%). The mean maximum temperature was highest (33.25°C) for the fourth harvest and lowest (30.25°C) for the first harvest. The mean minimum temperature was highest (25.01°C) for the fourth harvest and lowest (21.83°C) for the second harvest.

Table 24. Weather parameters during crop growth period

Sl. No.	Weather parameters	Transplanting to first harvest	First harvest to second harvest	Second harvest to third harvest	Third harvest to fourth harvest
1.	Total rainfall (mm)	384.21	6.70	0.00	30.40
2.	Mean relative humidity (%)	81.34	69.45	87.72	94.54
3.	Mean maximum temperature (°C)	30.25	31.07	32.13	33.25
4.	Mean minimum temperature (°C)	23.58	21.83	22.23	25.01

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DISCUSSION

The results of the experiment are discussed below:

I. Variability

Presence of genetic variability is a pre-requisite for any plant breeding programme to be successful. Identification of superior clones and later vegetative multiplication can lead to immediate improvement in the level of fodder production in guinea grass as seed propagation need not be resorted to for multiplication. The population of this grass wherein both sexual and asexual methods of reproduction are prevalent will be highly heterogeneous and the detection of superior individuals will be the main problem to be tackled.

The base material for the present study was the seed progeny raised from open pollinated seeds of four mutant clones of FR 600 and two control varieties viz., FR 600 and Makueni. The genetic variability which was expected to be present among the progenies of the above mentioned six families was confirmed by the results obtained.

The six families exhibited significant differences for seven out of the ten characters studied. The families when analysed separately, revealed significant differences among the progenies of either one or more of the six families

DISCUSSION

for eight out of the ten characters assessed. As genetic variability exists within the open pollinated progenies, it is evident that sexual reproduction exists to some extent in this crop in the families studied.

As genetic variability exists within the families, it is possible to exercise effective selection within the families for identifying genetically superior individuals.

The range of variability in attributes related to fodder production pointed towards the heterozygosity of the parental clone and the prevalence of sexuality to a high degree, thereby, providing high scope for selection.

The study of a larger array of material derived from both selfed and open pollinated seeds will be rewarding from the point of view of evaluation of superior clones.

Variance helps to measure the variability in a population. The estimate of variance components indicated only very little differences between phenotypic and genotypic variances for the characters viz., free proline content of leaves and inflorescence count (Table 19). This indicates that variations observed in these characters were mainly due to genetic causes and that environment had only negligible influence over them and there is better scope of improvement of these characters through selection.

On the other hand, the characters viz., height of grasses, tiller count, leaf/stem ratio, leaf area, root length, reaction to collar rot, green fodder yield and dry matter yield showed wide difference between phenotypic and genotypic variance, denoting the greater influence of environment over these characters.

Soil moisture analysis

The data on mean soil moisture percentage measured during the peak summer months (January to April) revealed the lowest soil moisture percentage during February. The proline content was measured on the dried leaves of the third harvest done on March 7, the growth acquired during the 45 days period from January 22. This coincided with the lowest soil moisture percentage in the soil and no rainfall was received during this period. The analysis of variance of soil moisture percentage did not show any significant difference between the families indicating that uniform moisture conditions prevailed in the experimental plots. Hence, a comparison of the proline content of the different varieties could be made.

II. Genetic parameters

The success of breeder in improving a crop depends on the existence and exploitation of genetic variability to the fullest extent. The estimation of genetic variability alone is insufficient to give a complete information about the magnitude of improvement that can be achieved. Therefore estimation of parameters like genotypic coefficient of variation (GCV), heritability (H^2) and genetic advance (GA) are indispensable.

In the present study, the PCV was in general high for all the characters as compared to the GCV. Height of grasses and free proline content of leaves exhibited a little difference between GCV and PCV indicating that the variations observed in these characters are more influenced by genetic causes than environment. Wide differences were observed between the estimates of PCV and GCV for the characters such as tiller count, leaf/stem ratio, leaf area, root length, inflorescence count, reaction to collar rot, green fodder yield and dry matter yield indicating that these characters are influenced more by environment than by the genetic make up.

High genotypic coefficient of variation observed for proline content, inflorescence count and reaction to collar rot observed in the present study of 60 progenies indicates the presence of high degree of genetic variability and better scope for the improvement of these characters through selection.

High GCV values were recorded for inflorescence count in this study. However moderate GCV values were recorded by Subramaniam (1979) in little millet and Thejaseebhai (1988) in guinea grass while Joseph (1988) recorded low GCV values for this character in guinea grass.

Free proline content of leaves recorded high GCV values in the present study in conformity with the findings of Mereena (1989) in cowpea and Sudharani (1989) in blackgram. But Anitha (1989) recorded moderate GCV values for this character in greengram.

The characters viz., height of grasses, tiller count, leaf area, leaf/stem ratio, root length, green fodder yield and dry matter yield showed low genotypic coefficient of variation, indicating the low amount of genetic variability in these characters, thereby limiting the scope for the improvement of these characters through selection.

The low GCV values recorded for plant height in the present study is in agreement with the findings of Joseph (1988) and Thejaseebhai (1988) in guinea grass, Phul et al. (1972) and Nair and Gupta (1977) in fodder oats, Mahudeswaran and Murugesan (1973) and Appadurai et al. (1977) in ragi, Sethi and Singh (1978) in barley, Tyagi et al. (1980) in pearl millet, Mathur and Patil (1982) in sorghum and Liu (1984) in millets. But Sindagi et al. (1970) in sorghum and Tyagi et al. (1977) in oats recorded moderate GCV estimates for this character. However Sreenivasan (1983) in guinea grass, Swarup and Chaugale (1962) in sorghum, Dhanakodi (1980) in ragi, Viswanatha et al. (1981) in fox tail millet and Rahaman and Roquib (1987) in oats recorded low GCV values for this character.

In the present study, tiller count recorded low GCV estimates. This was in conformity with the results obtained by Joseph (1988) and Thejaseebhai (1988) in guinea grass, Sangha and Singh (1973) and Tyagi et al. (1980) in bajra and Singh and Patil (1983) in barley. Moderate values of GCV were observed for this character by Sreenivasan (1983) in guinea grass, Mahudeswaran and Murugesan (1973) and Appadurai et al. (1977) in ragi, Nair and Gupta (1977) in oats, Sethi and Singh (1978) in barley, Subramaniam (1979) in little millet and Mathur and Patil (1982) in sorghum. However high GCV values were recorded for this character by Tyagi et al. (1977) and Rahaman and Roquib (1987) in oats, Mohamed (1979) in *Echinochloa frumentaceae*, Viswanatha et al. (1981) in fox tail millet and Reddy (1982) in little millet.

The low GCV estimates recorded for leaf/stem ratio in the present study is in agreement with the findings of Joseph (1988) in guinea grass. But moderate GCV values were recorded for this trait by Sreenivasan (1983) and

Thejaseebhai (1988) in guinea grass, Tyagi et al. (1977) in oats and Singh and Patil (1983) in barley. Dhanakodi (1980) recorded high GCV values for leaf/stem ratio in ragi.

Leaf area recorded low values of GCV in the present study. But, Sethi and Singh (1978) observed moderate values of GCV for this character in barley.

The low GCV estimates recorded for green fodder yield is in conformity with the findings of Joseph (1988) in guinea grass and Tyagi et al. (1980) in pearl millet. Moderate values of GCV were recorded for this character by Thejaseebhai (1988) in guinea grass, Sangha and Singh (1973) and Mohan and Dua (1984) in pearl millet, Nair and Gupta (1977) and Tyagi et al. (1977) in fodder oats and Sethi and Singh (1978) in barley. But, high estimates of GCV were recorded for green fodder yield by Sreenivasan (1983) in guinea grass, Swarup and Chaugale (1962) and Sindagi et al. (1970) in sorghum, Mohamed (1979) in *Echinochloa frumentaceae*, Dhanakodi (1980) in ragi and Rahaman and Roquib (1987) in fodder oats.

Dry matter yield recorded low GCV values in the present study. This is in agreement with the results obtained by Thejaseebhai (1988) in guinea grass, Nair and Gupta (1977) in oats, Tyagi et al. (1980) in bajra and Mathur and Patil (1982) in sorghum. But Joseph (1988) in guinea grass, Mahudeswaran and Murugesan (1973) in ragi and Sethi and Singh (1978) in barley recorded moderate GCV values for this trait, while high GCV values were recorded by Sreenivasan (1983) in guinea grass, Appadurai *et al.* (1977) in ragi, Tyagi *et al.* (1977) in oats, Mohamed (1979) in *Echinochloa frumentaceae*, Viswanatha *et al.* (1981) in fox tail millet, Reddy (1982) in little millet and Singh and Patil (1983) in barley.

In the present study of the 60 progenies proline content, height of grasses and inflorescence count recorded high heritability values indicating that, they were less influenced by environment. High heritability recorded for free proline content of leaves was in agreement with the results of Mereena (1989) in cowpea. However Anitha (1989) reported low heritability for this character in greengram while Sudharani (1989) reported moderate heritability for this character in blackgram.

The high heritability estimate recorded in this study for height of grasses is in conformity with the reports of Thejaseebhai (1988) in guinea grass, Swarup and Chaugale (1962), Sindagi *et al.* (1970), Mathur and Patil (1982) and Kaushik (1987) in sorghum, Mahudeswaran and Murugesan (1973) in ragi, Gupta and Nanda (1971) and Tyagi *et al.* (1980) in bajra, Nair and Gupta (1977), Tyagi *et al*. (1977) and Choubey and Gupta (1987) in fodder oats, Tan *et al*. (1977) in *Bromus inermis*, Quesenberry *et al*. (1978) in rhodes grass, Sethi and Singh (1978) and Singh and Patil (1983) in barley, Riley and Vogel (1983) in sand blue stem, Sachs and Coulman (1983) in reed canary grass and Rao *et al*. (1984) in Italian millet. However, moderate heritability estimates for this trait was observed by Phul *et al*. (1972) and Rahaman and Roquib (1987) in fodder oats and Appadurai *et al*. (1977) in ragi, while Joseph (1988) observed low heritability estimates for this character in guinea grass.

Inflorescence count recorded high values of heritability. This was in agreement with the results obtained by Joseph (1988) and Thejaseebhai (1988) in guinea grass and Sachs and Coulman (1983) in reed canary grass. However, Anonymous (1980) had reported moderate heritability estimate for this character in *Andropogon gayanus*.

Moderate values of heritability were recorded for leaf area, root length and dry matter yield. Moderate heritability recorded for leaf area is in agreement with the reports of Gupta and Gupta (1971) and Gupta and Nanda (1971) in bajra. High values of heritability were recorded for this character by Tan *et al*. (1977) in *Bromus inermis*, Sethi and Singh (1978) in barley and Manga and Sidhu (1984) in fodder oats. Singhania *et al*. (1977) observed low heritability estimate for this character in sorghum.

The moderate heritability estimate recorded for dry matter yield is in conformity with the results obtained by Thejaseebhai (1988) in guinea grass, Anonymous (1980) in *Andropogon gayanus* and Mohan and Dua (1984) in pearl millet. High heritability values for this trait was observed by Joseph (1988) in guinea grass, Mahudeswaran and Murugesan (1973) and Appadurai *et al*. (1977) in ragi, Nair and Gupta (1977) and Tyagi *et al*. (1977) in fodder oats, Hooda *et al*. (1978) in pearl millet, Sethi and Singh (1978) in barley, Mathur and Patil (1982) in sorghum and Rao *et al*. (1984) in Italian millet. But Tyagi *et al*. (1980) recorded low heritability value for this character in pearl millet.

Green fodder yield, tiller number, reaction to collar rot and leaf/stem ratio recorded low heritability values. The low heritability estimate recorded for green fodder yield is in agreement with the findings of Singhania *et al*. (1977) in sorghum and Riley and Vogel (1983) in sand blue stem. But high heritability values were observed for this character by Joseph (1988) in guinea grass, Swarup and Chaugale (1962) and Sindagi *et al*. (1970) in sorghum, Phul *et al*. (1972), Nair and Gupta (1977), Tyagi *et al*. (1977) and Choubey and Gupta (1987) in fodder oats, Tan *et al*. (1977) in *Bromus inermis*, Sethi and Singh (1978) and Singh and Patil (1983) in barley and Tyagi *et al*. (1980) in pearl millet. Moderate heritability estimates were reported for green fodder yield by Thejaseebhai (1988) in guinea grass, Phul et al. (1972) in oats, Hooda et al. (1978) and Mohan and Dua (1984) in pearl millet and Berg and Hill (1983) in timothy.

Tiller number recorded low heritability estimate in the present study. This was in conformity with the results obtained by Gupta and Nanda (1971) in bajra and Phul et al. (1972) and Rahaman and Roquib (1987) in fodder oats. However, moderate values of heritability were recorded for this character by Joseph (1988) and Thejaseebhai (1988) in guinea grass, Tyagi et al. (1980) in pearl millet and Singh (1987) in oats. But Phul et al. (1972), Nair and Gupta (1977), Tyagi et al. (1977) and Bahl et al. (1988) in oats, Mahudeswaran and Murugesan (1973) and Appadurai et al. (1977) in ragi, Sangha and Singh (1973) in bajra, Tan et al. (1977) in *Bromus inermis* and Sethi and Singh (1978) in barley recorded high values of heritability for this trait.

Low heritability estimates for leaf/stem ratio recorded in this study is in agreement with the results obtained by Singhania et al. (1977) in sorghum and Singh and Patil (1983) in barley. However, moderate heritability values were recorded by Joseph (1988) in guinea grass and Vaithalingam (1979) in sorghum, while Thejaseebhai (1988) in guinea grass, Tyagi et al. (1977) and Manga and Sidhu (1984) in oats recorded low heritability estimates for this character.

Heritability values alone may not provide a clear predicability of the breeding value. Heritability in conjunction with genetic advance is more effective and reliable in predicting the resultant effect of selection, than heritability alone.

In the present study, the genetic advance expressed as percentage of the mean of the population was high for inflorescence count and proline content and low for all the other characters viz., reaction to collar rot, dry matter yield, green fodder yield, leaf area, root length, height, tiller number and leaf/stem ratio.

Mereena (1989) in cowpea and Sudharani (1989) in blackgram also recorded high estimates of expected genetic advance for the free proline content of leaves as in the present study. But Anitha (1989) reported low estimates of genetic advance for this character in greengram.

High values of genetic advance was recorded for inflorescence count, contrary to the findings of Joseph (1988) and Thejaseebhai (1988).

The low estimates of genetic advance for dry matter yield is in conformity with the results obtained by

Joseph (1988) and Thejaseebhai (1988) in guinea grass, Nair and Gupta (1977) in oats, Sethi and Singh (1978) in barley, Tyagi _et al_. (1980) and Mohan and Dua (1984) in pearl millet and Mathur and Patil (1982) in sorghum. However, moderate values of genetic advance was observed by Mahudeswaran and Murugesan (1973) and Appadurai _et al_. (1977) in ragi and Mathur and Patil (1982) in sorghum. Low values of genetic advance for this character was recorded by Tyagi _et al_. (1977) in oats, Reddy (1982) in little millet, Kumar (1982) and Prakash (1983) in bajra and Singh and Patil (1983) in barley.

Green fodder yield recorded low values of genetic advance. This is in conformity with the results obtained by Joseph (1988) and Thejaseebhai (1988) in guinea grass and Mohan and Dua (1984) in pearl millet. Moderate values of genetic advance was reported by Sangha and Singh (1973) in pearl millet, Tyagi _et al_. (1977) in oats and Singh and Patil (1983) in barley. But high estimates of genetic advance for this character was observed by Swarup and Chaugale (1962) and Sindagi _et al_. (1970) in sorghum, Nair and Gupta (1977) and Choubey and Gupta (1987) in oats, Sethi and Singh (1978) in barley and Kumar (1982) and Prakash (1983) in bajra.

Leaf area recorded low estimates of genetic advance, which was in agreement with the results obtained by Sethi and Singh (1978) in barley.

The low values of genetic advance observed for height of grasses are in agreement with the results observed by Joseph (1988) and Thejaseebhai (1988) in guinea grass, Phul et al. (1972), Nair and Gupta (1977) and Tyagi et al. (1977) in oats, Mahudeswaran and Murugesan (1973) and Appadurai et al. (1977) in ragi, Sethi and Singh (1978) in barley and Tyagi et al. (1980) in pearl millet. Contrary to this, high values of genetic advance for this character was observed by Swarup and Chaugale (1962) and Kaushik (1987) in sorghum, Prakash (1983) in bajra and Choubey and Gupta (1987) and Bahl et al. (1988) in oats. However, moderate values of genetic advance for this trait was recorded by Sindagi et al. (1970) in sorghum.

Tiller count recorded low estimates of genetic advance. Similar results were obtained by Joseph (1988) and Thejaseebhai (1988) in guinea grass, Phul et al. (1972) and Nair and Gupta (1977) in oats, Mahudeswaran and Murugesan (1973) and Appadurai et al. (1977) in ragi, Sangha and Singh (1973), Tyagi et al. (1980) and Mohan and Dua (1984) in bajra and Sethi and Singh (1978) and Singh and Patil (1983) in barley. But moderate values of genetic advance was recorded by Tyagi et al. (1977) in oats and Mathur and Patil (1982) in sorghum while Bahl et al. (1988) in oats recorded high estimates of genetic advance for this character.

The low estimates of genetic advance recorded for leaf/stem ratio are in agreement with the results obtained by Joseph (1988) and Thejaseebhai (1988) in guinea grass and Singh and Patil (1983) in barley. But Tyagi et al. (1977) recorded moderate values of genetic advance for this trait in oats.

High heritability and high genetic advance were recorded by inflorescence count and free proline content of leaves. High heritability along with high genetic advance indicates the role of additive gene action for the character concerned, as suggested by Panse (1957).

High heritability and low genetic advance were recorded for height of grasses. Moderately high heritability and low genetic advance were noted for leaf area, root length and dry matter yield. High heritability and low genetic advance observed in the present study are attributed to the role of non-additive genes in the expression of these characters (Panse, 1957).

Low heritability and low genetic advance were observed for tiller number, leaf/stem ratio, reaction to collar rot and green fodder yield indicating that these characters were highly influenced by environmental factors.

III. Selection Index

A selection index was formulated to increase the efficiency of selection, taking into account the important characters contributing to yield.

Based on the index values, the top ranking six progenies namely progeny 4 of MC-23, progeny 8 of Makueni, progeny 5 of Makueni, progeny 5 of MC-23, progeny 6 of MC-23 and progeny 8 of MC-23 were identified as genetically superior from among the seed progeny raised from open pollinated seeds of the four mutant clones viz., MC-2, MC-14, MC-16 and MC-23 and two control varieties, namely FR-600 and Makueni.

IV. Weather parameters

The green matter yield and dry matter yield were the highest when the rainfall was highest (first harvest) and lowest when the rainfall was lowest i.e., nil (third harvest). The green fodder yield is the effect of net photosynthesis which in turn is determined by the complex interaction of the various weather parameters like rainfall, relative humidity, maximum temperature, minimum temperature etc. to a large extent.

The study revealed that ample genetic variability was present among the families studied, namely FR-600, Makueni, MC-2, MC-14, MC-16 and MC-23. Hence, scope for selection is immense within all these families. An effective selection can be done based on green fodder yield, tiller number, height, leaf area, and leaf/stem ratio within these families to unravel high yielding superior genotypes. Based on the present study, the 60 progenies evaluated were ranked according to the selection index, which revealed 4 progenies of MC-23 and 2 progenies of Makueni as top ranking when 10 per cent selection was exercised. These clones could be ideally grown under partially shaded condition of coconut plantations.

SUMMARY

SUMMARY

The present investigation was undertaken with the objective of identifying genetically superior genotypes among seedling progeny raised from guinea grass clones with higher fodder yield and adaptability under partial shade of coconut gardens.

Observations viz., green matter yield, dry matter yield, tiller count and root length were taken on the base material consisting of seedling progeny raised from M_1 generation of four mutant clones of FR-600 viz., MC-2, MC-14, MC-16 and MC-23 and two control varieties namely FR-600 and Makueni. The top ranking ten clumps from each of the six clones based on the above observations were taken for clonal progeny analysis.

The sixty clumps selected from the base material were planted into clonal progeny in a progeny row trial, six clones each with ten progenies were tried in a compact family block design with four replications in lines of ten plants/treatment with a spacing of 40 cm x 20 cm.

Four harvests were done, the first one, after 75 days of transplanting and the subsequent three, at 45 days interval. The observations viz., height, tiller count, inflorescence count, leaf/stem ratio, leaf area, green fodder yield and dry matter yield were recorded at the time of

each harvest. The soil moisture content was noted during the peak summer months i.e., from January to April. Analysis for free proline content of leaves was done on dried leaves of the third harvest. The reaction to collar rot disease was also recorded. The weather parameters viz., total rainfall, mean relative humidity, mean maximum temperature and mean minimum temperature that prevailed during each of the crop growth periods were also noted.

Besides working out the analysis of variance to find out the differences among the families and the progenies, the genetic parameters, namely, phenotypic coefficient of variation, genotypic coefficient of variation, heritability and expected genetic advance as percentage of mean were also computed. A selection index was formulated and based on this index, genetically superior genotypes were identified.

The six families of guinea grass studied exhibited significant differences for seven characters viz., height of grasses, tiller count, leaf/stem ratio, leaf area, root length, inflorescence count and proline content for which selection is effective. Green fodder yield, dry matter yield and reaction to collar rot did not show any significant difference among the families.

As regards five characters namely height of grasses, tiller count, leaf area, inflorescence count and proline content, there was significant differences among progenies, but not in all families. Although there was significant difference among the families for leaf/stem ratio and root length no significant difference among the progenies were observed within the families. Collar rot, green fodder yield and dry matter yield exhibited significant difference among the progenies studied. However, these characters were non-significant among the families. For all the characters except leaf/stem ratio and root length, genetic variability existed within the families and hence selection will be effective within the families also for the improvement of these characters.

Of the 60 progenies studied, the phenotypic coefficient of variation was in general high for all the characters as compared to the genotypic coefficient of variation. GCV values exceeding 30 per cent were recorded for inflorescence count, reaction to collar rot and free proline content. All the other characters studied recorded GCV values less than 15 per cent.

Height of grasses and free proline content of leaves showed little difference between σ^2p and σ^2g. However, for all the other characters studied wide differences existed between σ^2p and σ^2g indicating higher environmental influence.

Heritability estimates were high for inflorescence count, height of grasses and free proline content of leaves indicating lesser environmental influence on these characters. Genetic improvement of these characters can be had through selection. Moderate values of heritability were recorded for leaf area, root length and dry matter yield. Green fodder yield, tiller number, reaction to collar rot and leaf/stem ratio recorded low heritability values indicating higher environmental influence on these characters.

Genetic advance expressed as percentage of mean was high for free proline content of leaves and inflorescence count and low for all the other characters. High heritability coupled with high genetic advance was observed for free proline content of leaves and inflorescence count. Height of grasses recorded high heritability and low genetic advance. Moderately high heritability and low genetic advance was observed for leaf area, root length and dry matter yield. Green fodder yield, tiller number, leaf/stem ratio and reaction to collar rot recorded low heritability coupled with low genetic advance.

A selection index formulated on the basis of height, tiller number, leaf area, leaf/stem ratio and green fodder yield identified the progenies; 4 of MC-23, 8 of Makueni, 5 of Makueni, 5 of MC-23, 6 of MC-23 and 8 of MC-23 with the highest scores as genetically superior from among the 60 progenies when ten per cent selection was exercised.

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GENETIC EVALUATION OF $M_2 V_1$ GUINEA GRASS *(Panicum maximum Jacq.)* CLONES UNDER PARTIALLY SHADED CONDITIONS

By

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ABSTRACT OF THE THESIS
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ABSTRACT

The top ranking ten clumps from the open pollinated seed progeny of each of the four mutant clones of guinea grass variety FR-600 viz., MC-2, MC-14, MC-16 and MC-23 and two control varieties FR-600 and Makueni were studied in terms of green fodder yield, dry matter yield, tiller count and root length and were evaluated to identify genetically superior clones.

The six clones comprising of 60 progenies were evaluated in a field trial in a compact family block design with four replications.

Analysis of variance carried out for ten characters revealed significant differences among the six families for seven characters. The familywise analysis of variance carried out displayed significant differences among the progenies in either one or more of the families for eight out of the ten characters, indicating that sexual reproduction is prevalent in the crop at least to some extent. As genetic variability existed within the families, selection will be effective within the families too.

Genotypic coefficient of variation was maximum for inflorescence count and minimum for height of grasses.

High heritability estimates were recorded for inflorescence count, height of grasses and free proline content of leaves, indicating that its genetic improvement can be effected through selection. Moderate heritability values were recorded for root length, leaf area and dry matter yield while tiller number, leaf/stem ratio, green fodder yield and reaction to collar rot recorded low heritability values.

Genetic advance expressed as percentage of mean was high for free proline content of leaves and inflorescence count and low for all the other characters.

A selection index based on plant height, tiller number, leaf area, leaf/stem ratio and green fodder yield identified six of the progenies as genetically superior from among the sixty progenies studied, when ten per cent selection was exercised. The top ranking six progenies belonged to the families MC-23 and Makueni.