yield which was on par with the yield of Thankaikulam silt, sea weed residue, green leaf manure, farm yard manure and biogas slurry treatments. Sea weed residue also recorded higher pod yield, which is in conformity with the report of Koo (1988).

Protein content

There was a significant difference in the protein content of kernels due to the treatments. The protein content ranged from 5.69 to 17.81 per cent. The treatment with the application of arecanut waste recorded the highest protein content (17.81 per cent). The oil percentage ranged from 34.7 to 48.4 per cent.

Total oil yield

The treatment with the application of biogas slurry recorded the highest oil percentage (48.4 per cent) which was on par with pressmud applied treatment. The total oil yield ranged from 1.3 to 4.9 g/pot. The treatment with the application of arecanut waste gave the highest oil yield, which was on par with pressmud applied treatment. The higher content of oil content in biogas slurry applied treatment is due to high content of N,P and K. Balanced supply of these three nutrients play a major role. This is in conformity with the results of Rani Perumal *et al.*, (1978).

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HETEROSIS STUDIES IN BITTERGOURD(*Momordica charantia*)

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ABSTRACT

Four lines were crossed with fifteen testers and the resultant sixty hybrid combinations, were evaluated along with their parents for heterosis, for fruit yield and their component characters. Observations were recorded on 12 yield component characters. Appreciable amount of heterosis was observed for all the characters under study. The F_1 hybrids L_3 x T_1 (Pusa Visesh x MC.13) L_2 x T_4 (MC. 84 x MDU.1), and L_{11} x T_1 (DFH. 21 x MC.13) gave the highest fruit yield per vine and they showed 65.74, 61.92 and 48.04 per cent heterosis for yield over the standard variety (MC.84). The best performing F_1 hybrid of the study L_3 x T_1 (Pusa Visesh x MC.13) recorded 65.74 per cent heter osis over the standard variety (MC.84) and 49.00 per cent heterosis over the better parent (MC.13).

KEY WORDS : Bitter Gourd, Hetorosis

Bittergourd (*Momodica charantia*L.) is one of the most important nutritious cucurbitaceous vegetables, known for its peculiar characteristic bitter taste. It is highly cross pollinated and its monoecious nature has resulted in variations in several qualitative and quantitative characters. Despite of it importance and adaptability not much work has been done especially in crop improvement aspects. The present investigation was taken up using a 4 X 15 line x tester crossing system to produce promising F1 hybrids in this crop.

MATERIALS AND METHODS

The bittergourd material chosen for this study consisted of 15 lines and four testers which were crossed using the Line x Tester making system to produce 60 hybrids. The parents used were Co.1 (L_1), MC.84 (L_2), Pusa Visesh (l_3), Coimbatore local (L_4), Perumbavoor local (L_5), Vadakkancheri

Table 1. Heterosis and superior F_1 - combinations for 15 x 4 Line x Tester analysis in bittergourd

Character	Range of heterosis over better parent (%)	Three top performing combinations with heterosis (% in parenthesis) over best check for different characters
Vine length (m)	-30.37 to 43.50	L_{10} x T_1 (71.24) L_{11} x T_1 (51.46) L_1 x T_1 (31.46)
Number of primary branches per vine	-35.98 to 39.62	L_2 x T_4 (41.59) L_3 x T_4 (35.39) L_{10} x T_1 (35.39)
Node number of first female flower production	-56.52 to 47.73	L_{10} x T_3 (-30.23) L_{13} x T_3 (-22.48) L_{11} x T_3 (-19.92)
Days to first harvest	-15.96 to 19.94	L_{13} x T_3 (-11.41) L_5 x T_2 (-9.61) L_2 x T_2 (-8.73)
Fruit length (cm)	-47.71 to 22.71	L_{11} x T_2 (32.55) L_{13} x T_2 (32.41) L_5 x T_4 (13.70)
Fruit diameter (cm),	-45.59 to 31.33	L_2 x T_3 (20.91) L_{10} x T_3 (16.82) L_{14} x T_2 (16.59)
Fruit flesh thickness (cm)	-43.40 to 14.00	L_{15} x T_1 (30.00) L_3 x T_4 (18.00) L_{10} x T_2 (18.00)
Edible portion of fruits (%)	-24.59 to 18.89	L_8 x T_2 (14.95) L_2 x T_4 (13.10) L_4 x T_4 (11.78)
Number of fruits per vine	-49.42 to 77.95	L_{11} x T_4 (142.94) L_{12} x T_4 (137.60) L_{14} x T_4 (128.14)
Mean fruit weight (kg)	-68.89 to 32.11	L_9 x T_2 (12.65) L_{10} x T_1 (11.52) L_3 x T_2 (7.74)
Fruit field per vine (kg)	-64.41 to 49.00	L_3 x T_1 (65.74) L_2 x T_4 (61.92) L_{11} x T_1 (48.04)
Crop duration (days)	-11.55 to 9.37	L_7 x T_3 (-10.78) L_7 x T_2 (-9.92) L_3 x T_2 (-7.56)

local (L_6), Pudur local (L_7), Coimbatore long green (l_8), Udayamartandom local (L_9), Ottanchathram local (L_{10}), DFH.21 (L_{11}),DFH.77 (L_{12}), DFH.55 (L_{13}), DFH.72 (L_{14}), MC.47 (L_{15}), MC.13 (T_1), VK.1. Priya (T_2), Arka Harit (T_3) and MDU.1 (T_4).

A total of 60 F_1 hybrids and their respective parents were raised in a randomised block design with three replications during June- November, 1993. An interrow spacing of 2.5 m and intrarow spacing of 2.0 m was adopted and the vines were trained to *pandal*. Four seeds per pit were sown to obtain a good stand, but only two seedling per pit was retained, making a total of eight seedlings per genotype per replication. Observations were recorded on eight plants per replication on 12 important characters. Heterosis was calculated as the percentage of F_1 performance in the favourable direction of its better parents (dii) as well as standard variety (diii) for each character. The best parental lines were established individaully for different characters based on their performance in the line X texter mating system. Accordingly L_2

(MC.84) a high yielding commmercial cultivar, was kept as the standard variety.

RESULTS AND DISCUSSION

The range of heterosis percentage in F_1 crosses varied from 9.37 (crop duration) to 77.95 (number of fruits per vine) over better parental values (Table1). Out of 60 F_1 hybrids, the heterotic effects over better parents were observed in 24 crosses for vine length, 30 for number of primary branches per vine, 46 for node number of first harvest, 5 for fruit length, 3 fruit diameter, 13 for fruit flesh thickness, 20 for edible portion of fruits, 39 for number of fruits per vine 10 for mean fruit weight, 19 for fruit yield per vine, and 10 for crop duration. Highly significant differences were observed among the treatments.

Among the parents, Pudur local (L_7) and Arka Harit (T_3) were the earliest in days to first harvest, and lower node number of first female flower production and lesser crop duration. The ovule parent Pusa Visesh (L_3) performed better in characters like fruit diameter and mean fruit weight, while the male parent T_1 performed better for vine length, number of primary branches, fruit flesh thickness, edible portion of fruits, number of fruits per vine and fruit yield pervine. The parent L_2 performed best for characters like number of primary branches, and fruit yield per vine, whereas L_{14} gave highest vine length and number of fruits per vine. The highest fruit length was observed in parent L_8, fruit flesh thickness in L_{13} and edible porting of fruits in L_4. The male parent T_4 performed best for fruit length, and mean fruit weight. The superiority of L_3 (Munshi, 1991), L_2 (Devadas, 1993),L_1 and L_8 (Lawande and Patil, 1990) and T_4 (Gopalakrishnan, 1986) for various yield components have been reported earlier.

The range of heterosis over better heterotic effect of F_1 hybrids exhibiting the highest percentage of heterosis when compared the standard variety for different characters included. Earlier Ranpise (1985), Gopalakrishnan (1986), Lawande and Patil (1989) and Devadas (1993) have also reported standard heterosis in bettergourd.

The first top three hybrids L_3 x T_1, L_2 x T_4 and L_1 x T_1 showed 65.74, 61.92 and 48.04 per cent hetetosis. It was observed that the total yeild of fruits per plant in bittergourd is mainly dependent upon the fruit-weight and number of fruits per plant. The number of fruits per plant influenced by the size of the fruits (length and diameter) and vegetative vigour (vine length and branching). The fruit weight increases or decreases depending upon the number of fruits and size of fruits. The seeds per fruit and seed weight per fruit are also directly related to the size of the fruits. Early fruiting tends to produce large number of fruits. The results indicated that from the economic point of view, it was useful to utilise the parental lines having important characters like earliness, vegetative vigour, and higher fruit size, number and weight associated with yield in order to achieve higher yeilds in F_1 hybrids of bittergourd.

The best F_1 hybrids L_3 x T_1 (Pusa Visesh x MC.13) which gave 65.74 per cent higher yield over the standard variety MC.84 (L_2) can be exploited for commercial cultivation.

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