

Effect of cluster setting on yield of 'Dashehari' mango (*Mangifera indica*)*

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A typical phenomenon in mango (*Mangifera indica* L.) in which the fruits set at the tips of the floral panicles in clusters has been observed in the past in mango belt of Malihabad, Lucknow, and the adjoining areas of Uttar Pradesh. The phenomenon, which is locally called *jhumka*, means cluster, does not occur every year as reported by Kumar and Ram (1997). The characteristic features of this disorder have been described by Khader (1989). Clustering was reported to have first occurred in 1982 in low proportion, but Prakash and Srivastava (1987) reported 80 % cluster fruit setting in 1984. Cluster fruit setting occurred in a number of mango varieties with varying degrees of intensity. Kumar (1994) reported where 80% affected 'Dashehari' mango trees. The crop loss due to clustering is often so high that the mango growers emphatically draw the attention of horticultural scientists. An estimated loss of crop due to clustering during 1993 was 60–80%. Taking in view the gravity of the disorder of this kind which can be judged by its impact on the crop loss and, in turn, on the economic loss, an attempt was made to assess both these losses in 'Dashehari' during the affected years.

The study was conducted on 100 mango trees spaced at 10 m × 10 m (1 ha) of cv 'Dashehari' planted in 1977 in the experimental orchard at the Central Institute for Subtropical Horticulture, Lucknow. The plants started bearing from 1982. The 'Dashehari' variety is irregular bearer and follows the rhythm of off and on years. The even numbers representing the years were the off, whereas the odd numbers were on years. From 1982 to 1998, there were 9 off years and 8 on years. The yield of individual plant was recorded up to 17 years of study. The plants during clustering years were grouped in 6 ranges of yields to determine how many plants fall in each range. Yields of a few normal bearing years were also grouped into these ranges for comparative study with cluster-bearing trees. Total number of bearing trees and those with no yield were also sorted out. The yields of plants in 1 clustering-affected on year was compared with yields of plants with the preceding normal bearing on year, and the

clustering affected off year with preceding normal off year to work out the estimated crop loss. Crop loss during 1982 and 1986 could not be worked out due to the fact that former was the first year of bearing and the 2 off years preceding the latter were clustering years. The monetary losses were calculated at the prevailing market prices of 'Dashehari' mango. Since the year 1998 (off) was affected by both clustering and excessive vegetative flush, the plants which did not bear fruit and their bearing status during the preceding 2 off years were also studied to know whether these plants were habitual non-bearers during preceding off years or not. Differences between the means of yields of cluster setting years and preceding normal bearing years were worked out following Student's t-test (test of significance between 2 means). Correlation coefficients were worked out between the yields and overall annual rainfall for the whole period of study.

Out of 17 years of bearing, cluster setting was observed in 7 years, whereas normal fruit setting was observed in remaining 10 years. The off years were more prone to cluster setting than the on years. Out of 7 clusters setting years, 6 were off years of fruiting. This may, probably, be due to less availability of pollengrains because of sparse flowering and low population of pollinators, which affected pollination process. Sharma *et al.* (1996) reported that higher fruit set with greater pollinator activity in mango. However, this factor only is one of the reasons of occurrence of clustering. Another reason for cluster setting during off years may be short period of effective pollination. William (1966) reported that, flowers of apple (*Malus pumila* Mill.) and pear [*Pyrus pyrifolia* (Burf. f.) Nakai var *culta* (Makino) Nakai] with a tendency to biennial bearing had a longer effective pollination period in years of heavy crops than in the alternating off years. Though no precise trend in the occurrence of cluster setting was observed, it was found that crop load during normal bearing years could lead to this disorder. During the course of study, it was observed that 3 continuous bearing years (1987 to 1989) were followed by 3 clustering years with an intervening normal year. Similarly, 4 continuous normal bearing years (1994 to 1997) were followed by a cluster setting year. Cheng *et al.* (1982) reported that excess

*Short note

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fruit bearing in the previous year affects the bearing capacity of flushes in the following year.

Ninety-five per cent of the randomly collected fruitlets from the cluster were found with brown shrivelled embryos and devoid of seeds. Majority of the fruitlets were misshapen. Clustered fruitlets were found to grow slowly and hardly grew beyond marble stage; thereafter they dropped down. Khader (1989) reported that 92 % of the clustered fruits had aborted embryos. Kumar and Ram (1997) suggested that lack of or poor pollination or fertilization could be one of the reasons of cluster setting of fruits in mango. In contrast, absence of seeds in clustered fruitlets, slow growth of fruitlets, some of them reaching up to marble stage then their drop, abnormal shape with brown and shrivelled embryos, and their presence distal to normal fruits collectively indicated that cluster setting may not be solely due to lack of pollination and fertilization, but may be probably due to stenospermocarp. Ram *et al.* (1976) reported that seedlessness in mango was not the result of failure of fertilization but due to embryo abortion which was referred to as stenospermocarp (Soule 1985). Nunez and Davenport (1983) reported that stenospermocarpic fruits were nearly always found distal to seeded fruitlets within the panicles. Chandler (1958) reported that fruitlets abscission from pea-size onwards was often associated with embryo abortion.

Though the present study was not temperature related, the role of temperature in embryo abortion in clustered fruitlets cannot be ruled out. Both, low and high temperatures at the time of fruit set have been reported by Whiley (1988) and Nunez-Elisea and Davenport (1983) to cause embryo abortion.

During 1982, clustering incidence was less and 162.80 kg fruits/ha could be harvested (Table 1). During 1984, severe incidence (85%) of clustering was recorded and only 43.06 kg fruits/ha were obtained. Prakash and Srivastava (1987) also reported 80 % incidence of clustering during 1984. Yield obtained during 1984 was compared with the production of 1982, both off-years, and it was found that the yield during the latter year was significantly reduced due to clustering incidence. After 1984, less incidence of clustering was noticed during 1986 and a yield of 205.42 kg/ha was obtained (Table 1). After getting normal yields for a consecutive period of 3 years (1987, 1988, 1989), trees suffered from 'clustering' during 1990 (70%) and a yield of 794 kg/ha was obtained which was significantly less than the yield (2,290 kg/ha) obtained during the preceding normal off-year (1988). During 1992, 75 % incidence of clustering was recorded which reduced the yield to 738 kg/ha and was significantly less than the preceding normal bearing off year (1988). Clustering incidence was reported up to 90 % during this year. The year 1993 was the only on year during the course of study, during which the crop suffered from clustering. About 80 % incidence of clustering was recorded during 1993, reducing the yield (616.95 kg/ha) significantly

Table 1 Yield pattern in mango during clustering and normal years

Year	Age of the trees	Yield (kg/ha)	Yield (kg/tree)	Clustering intensity or normalcy
1982	5	162.80	1.63	Low
1983	6	603.42	6.03	Normal
1984	7	43.06	0.43	Severe (85%)
1985	8	651.55	6.52	Normal
1986	9	205.42	2.05	Low
1987	10	1 273.10	12.73	Normal
1988	11	2 290.0	22.90	Normal
1989	12	3 915.06	39.15	Normal
1990	13	794.0	7.94	Severe (70%)
1991	14	2 856.60	28.56	Normal
1992	15	738.0	7.38	Severe (75%)
1993	16	616.95	6.17	Severe (80%)
1994	17	1 871.90	18.72	Normal
1995	18	5 187.52	51.88	Normal
1996	19	2 563.15	25.63	Normal
1997	20	3 854.0	38.54	Normal
1998	21	608.30	6.08	Low + excessive vegetative growth

compared with the preceding (1991) normal bearing on year's yield (2 856.60 kg/ ha). Kumar (1994) also reported 80 % incidence of clustering in 'Dashehari'.

The crop during 1998 suffered due to clustering and excessive production of vegetative shoots. It was recorded that 54 % trees produced fruits during the 2 preceding off years (1996 and 1994) besides bearing in on years did not bear at all during 1998 and all of them produced new flush during the March. Impact of excessive vegetative growth together with clustering was so drastic, that only 608.30 kg/ha yield could be obtained which was significantly less than that (2 563 kg / ha) obtained during the preceding off year (1996) and the ever lowest during the preceding 5 off years (Table 1). Conversion of reproductive phase to a vegetative phase during 1998, a freak year for the matter, was probably due to high rainfall during the year. After the harvest of the fruits in June 1997, the place received 500.7 mm rainfall from July 1997 to March 1998 (which included period of fruit bud differentiation for 1998 crop). Harris (1901) reported that in areas of heavy rainfall, mango trees produced a lot of vegetative growth but at the expense of fruiting and did not yield a good crop. Gandhi (1955) suggested that excess of moisture in the soil after October could retard formation of blossoms. Singh (1977) reported that mango needed a drought-induced stress period for bloom.

During cluster setting years, a majority of trees belonged to a yield range from 0 to 5 kg and a very few plants fell in higher yield group. During normal bearing years, the situation is reverse since the majority of plants fell in higher yield ranges. In 1998, the combined effect of cluster setting (low incidence) and that of excess vegetative growth was conspicuous. During this year, while 54 % trees did not bear fruit at all, the yield in 30 % trees was poor.

Table 2 Fruit-bearing status of 100 trees during clustering and normal years

Year	Yield range (kg)						Total number of bearing trees
	Lower range			Higher range			
	0	>0-5	>5-10	>10-20	>20-30	>30	
<i>Clustering year</i>							
1982	37	56	4	3	0	0	63
1984	36	64	0	0	0	0	64
1986	26	64	8	2	0	0	74
1990	2	48	23	19	5	3	98
1992	11	61	11	7	2	8	89
1993	3	54	26	14	2	1	97
1998	54	30	5	4	0	7	46
<i>Normal years</i>							
1988	1	1	17	38	22	21	99
1991	0	5	4	48	8	35	100
1994	0	14	27	29	12	18	100
1996	0	19	24	25	11	21	100

Table 3 Crop and economic losses/ha in mango due to clustering

Clustering	Crop loss (kg)	Economic loss (Rs/ha)
1984	120 (73.55)	360
1990	1 496 (65.30)	7 480
1992	1 552 (67.77)	7 760
1993	2 239 (78.40)	13 434
1998	1 955 (76.26)	29 325

The figures in parentheses are crop loss %

Crop loss due to cluster setting as compared to the preceding normal bearing (off or on year) was found to be enormous (Table 3). The crop loss varied from 65.30 % to 78.40 % depending on the severity of disorder. A crop loss of 60–80 % was estimated during 1993. Crop loss during 1998 need to be dealt with separately since the cluster setting was not high this year, but excessive vegetative flushing coupled with cluster setting caused 72.26 % crop loss. The economic loss was influenced both by the yield and the prevailing market rate of mango. While the monetary loss incurred during 1984 was Rs 360/ha, it reached Rs 13 434/ha during 1993. During the 1998, monetary loss of Rs 29 325/ha was worked out. Such a high economic loss during this year was due to high market rate of mango because of poor crop in mango-growing areas. Since the study was conducted on the crop loss in young growing plants, crop losses (kg/ha) increased with increase in age of the plants. Cluster fruit setting in mango has become common in the mango belt of Malihabad causing substantial crop and economic losses.

SUMMARY

A study was made during 1997–98 in 'Dashehari' mango (*Mangifera indica* L.). Crop losses due to cluster setting varied from 65.30 to 78.40 % /ha/ year, depending on the intensity of the disorder. Economic loss varied from Rs 360 to Rs 29 325/ha/year during the course of observation, depending on the prevailing market rate of 'Dashehari'.

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