

Seasonal Impact and Influence of Mango Stem Borer on Rejuvenation of Old Mango Orchard

S. B. Jadhav, R. S. Patil, S. S. Dhumal and V. N. Nale

Abstract – Top working technique helps to rejuvenate the old unproductive mango orchards into productive one. Forty years old local mango seedlings were beheaded at 2 m height from ground level at monthly interval and newly emerged shoots were grafted with three improved mango varieties. Significantly highest graft success was recorded in May beheading and grafted in August (84.68%) while, it was the least in September beheading and December grafting (24.79%). Amongst the varieties used as scion for grafting, cv. Kesar showed significantly higher grafting success (61.93%). The significantly highest graft survival was noticed by the beheaded trees in November followed by successive grafting in February (38.46%) while, the significantly least graft survival was observed for trees beheaded in March followed by successive grafting in June (9.21%). Most severe incidence of mango stem borer was noticed during summer to rainy season (25.33 to 74.66%) while, the least during winter season (4.17 to 12.00%). Considering the mortality, beheading of mango tree for top working is only recommended during, November followed by wedge grafting with scion cv. Kesar during February.

Keywords – Beheading, Grafting, Mango Stem Borer, Scion Varieties.

I. INTRODUCTION

Mango (*Mangifera indica*L.) is main fruit of Asia. It is referred to as 'superfruit'. The mango trees are growing well under a wide range of agroclimatic conditions of India. India is the largest producer of mango and ranks first in the area with 22.97 lakh ha, however, the productivity of mango in India (6.6 MT/ha) is far below than the world average [2]. Old orchards of commercial varieties as well as seedling originated mango trees, more than 50 years could be one of the reasons for low productivity of India. Low yielding mango plantations were considered as a liability than an asset to the grower. Rejuvenation of old seedling originated mango orchards through top working is the one of method of crop improvement. Considering the benefits of top working in fruit crops, since 2005, the Government of India has made provision of subsidies for rejuvenation of old orchards under NHM programme. But the mango stem borer is the one of hurdle in the mango rejuvenation. In this context, the present investigation was especially undertaken to provide technical input in standardization of mango top working technique in Western Maharashtra.

II. MATERIAL AND METHODS

The investigation was carried out at Mahatma Phule Krishi Vidyapeeth, Rahuri. Local seedling originated forty years old mango orchard consisting 216 trees was selected for beheading. The experiment was conducted in Factorial

Randomized Block Design with three replications. Two mango trees per replication were selected. The first factor comprised of year round beheading of local mango trees at monthly interval while, the second factor comprised of three scion varieties (*viz.* Kesar, Ratna and Sindhu) for wedge grafting. In second fortnight of every month, mango trees were headed back at 2m height from the ground level for a year; commencing from March, 2010 to February, 2011 by keeping well-spaced 2-4 primary branches on main trunk. For heading back, a sharp slanting cut towards inner side of branch was given to enhance the sprouting of apical buds from the periphery. To take care of pest and disease, the trunks were washed with carbaryl @ 4 g/l, after scrapping of old bark of beheaded trees and cut portion of branches were pasted with copper oxychloride (10%) as a preventive measures. It was followed by applying thick layer of cow dung on cut portion of beheaded trees to avoid excessive sap flow from pruned limbs and also to accelerate healing of pruned apical portion [17]. Immediately after beheading additional dose of one kilogram of Suphala (15:15:15 NPK) was applied to each tree, followed by irrigation. A recommended dose of fertilizer consisting 50 kg FYM and 1.5:0.5:0.5 kg NPK was applied to each tree in the month of June followed by irrigation. Alternate spray of Bavistin @ 2g/l + Curacron @ 2.5 ml / l or Captan @ 2g/l + Carbaryl @ 2g /l at monthly interval were given to prevent incidence of pest and diseases.

After sprouting, only 5-10 healthy apical shoots were retained on headed back branches for grafting. Regularly excessive bud sprouts on the main trunk and branches were immediately pinched off at weekly interval for healthy canopy management. Wedge grafting on selected apical stock-shoots of beheaded tree was undertaken within 5-10 weeks period, when copper red leaves of new stock-shoots turned to green colour, coupled with 5-10mm diameter of stock. A matured scion stick of same size was selected for grafting. Grafting was done at monthly interval from Jun, 2010 to May, 2011. Observations on growth parameters prior and after grafting in mango top working were recorded. Initial and final success and survival of grafts was evaluated at 30 and 90 days after grafting, respectively. A method described by Surulivelu [16] was employed for assessing the monthly cumulative incidence extent of larval infection of mango stem borer.

III. RESULTS AND DISCUSSION

A. Effect of Tree Beheading on Growth Parameters Prior to Grafting in Mango Top working

The data presented in Fig.1 revealed that the maximum number sprouts per branch (26.31) and minimum days required for stock shoot leaves turn to green (14.42) and

ready to graft (52.73) were recorded in July beheading and minimum number sprouts per branch (9.92) and maximum days required for stock shoot leaves turn to green (25.30) were observed in November beheading. The congenial conditions i.e. optimal temperature and high humidity in rainy season as compared to summer and winter season might have led to faster chlorophyll development and vegetative growth of stock, which resulted in less days to sprouting of stock and stock shoot leaves turn to green i.e. days to stock ready for grafting and more number of spouts per branch, in July beheading. These results are in accordance with [6] and [12] in cashew.

B. Effect of Beheading/Grafting Month and Scion on Days to Graft Sprout

Data depicting in Fig. 2 revealed that, early bud break (15.64days) was noticed in August grafting i.e. May beheading while, late sprouting (25.36days) was observed in December grafting and September beheading. The minimum mean days required for sprouting of grafts recorded in Kesar (18.01) and was at par with Ratna (18.19). The maximum mean days for graft sprouting were required in Sindhu (18.91). The grafts of Sindhu made in August required minimum days to sprout (15.06). The maximum was recorded in Sindhu (26.96) in December. This might be due to the variation in the genetic makeup, which influences the histological and physiological development of shoot. Similar finding were also observed [1],[3],[7],[8] and [10] with respect to mango.

C. Effect of Beheading/Grafting Month and Scion on Graft success and survival

The term graft success was associated with initial stage of graft sprouting i.e. 30 DAG while, graft survival was related to growth of sprouted graft upto 90 days after grafting.

The data in Table 1 revealed that the maximum (84.68%) graft success was recorded in August grafting and it was the minimum (24.79%) in December grafting. Survival was found to be more (38.46%) in February grafting and less (9.21%) in June grafting. The higher graft success during August could be attributed to high humidity (93-68.75%) stretched for long period in August, which might have prevented desiccation of active tissue, and resulted in production of new xylem and phloem permitting the vascular connection between the scion and root stock as compared to December.

The final graft survival was more in February grafts though the maximum percent of grafting success was in August. This could be because of higher infestation of stem borer. The stem borer infestation was more during June to September. In the later stage of the stem borer adult do not cause much damage to mango trees [11] and this might have resulted in more survival percentage during February. The grubs of stem borer caused maximum damage by tunneling inside the stem and branches. They feed on vascular tissue in the stem or branches and resulted in wilting of branches. The infested branches or stem initially turned black and eventually died. Kannan and Rao (2006) reported that stem borer were more predominant on the old age tree (> 15years) than young trees (0-5 years). Sevier damage of top worked

trees due to attack of stem borer was noticed by [14] in mango and [6] in cashew.

With respect to variety the maximum success (61.93%) and survival (26.74%) was observed in cv. *Kesar*, while, it was minimum in *Ratna* (50.01%) and (20.93%), respectively. The interaction effects between variety and grafting month recorded the higher graft success in August in *Sindhu* (87.76%) and it was at par with *Kesar* (85.41%) grafted in August. However, maximum survival percentage was recorded in *Kesar* with 42.40% in January, 40.66% February and 40.62% March grafting. Less success and survival was recorded in cv. *Ratna* grafted in May (21.72%) and June (7.93%), respectively. This might be due to having optimum nutrient and hormonal status as well as good callusing capacity of *Kesar* variety which make the plant harder and able to withstand against adverse climatic condition. These results are confirmation with [1],[3], [4],[8],[10], [13] in mango.

D. Percent cumulative stem borer incidence on monthly beheaded mango trees

The stem borer incidence was effectively influenced due to monthly beheading (Table 2a). At 360DAB stage trees beheaded in the month of May showed the most severe cumulative incidence (74.66%) which was followed by April (62.66%) and July (49.32%) beheaded trees. The least cumulative incidence of stem borer (4.17%) was recorded in the November beheaded trees followed by trees beheaded in October, January (5.33%, each) and December (6.67%). Irrespective of beheading months the incidence of stem borer could not visibly located upto 60 days after beheading. The incidence of mango stem borer was not recorded up to the longest duration of 270 days in the November beheaded trees followed by December and January (210 and 270 days, respectively). The higher cumulative incidence of stem borer (25.33 to 74.66%) was noticed during the period of March to September. An increased incidence of stem borer was noticed during the period of 60 to 150 days after beheading and remains constant thereafter. Hence, utmost care for control of stem borer needs to be undertaken during this particular period. Eventually, by considering an optimal graft survival (24.58 to 38.46%) and the least incidence of stem borer for long duration of one year (4.17 to 6.67%); it conclude that the mango top working in Western Maharashtra region of India be initiate with beheading of plants during the period of October to January followed by wedge grafting within a period of January to April. Attack of stem borer was started after beheading, as the activity of adults of the borer was intense from March to August and observations have revealed that adults are attracted in large numbers to such beheaded trees. Similar findings were observed [7] in cashew.

In second year of experimentation (2011-12) slightly increased incidence of stem borer was observed, but low incidence was recorded in October (13.67%), November (9.73%) and December (15%) beheading (Table 2b).

E. Mortality of Beheaded Trees

Table 3 indicates the extent of mortality of beheaded trees due to mango stem borer incidence during 2010-11 and 2011-12. More than 25% (27.17-77.78%) average

mortality was observed from March to September beheading mainly due to highest incidence of mango stem borer. Significantly less mortality was recorded in November (3.33%) followed by October (8.22%), January (8.28%), December (10.0%) and February (12.11%). During the second year 2011-12 the mortality was increased 5 to 24.22% over the 2010-11 year of experimentation. Considering the least mortality (3.33%) of mango trees November beheading was the best for mango top working. Similar results were also recorded [6] in cashew.

IV. CONCLUSION

For sustainable and effective mango top working, the seedling-originated, old trees should be beheaded in November and wedge grafted in February respectively preferably with scion cv. *Kesar*. However, scion cultivars like *Ratna* and *Sindhu* may be used as a choice of farmer.

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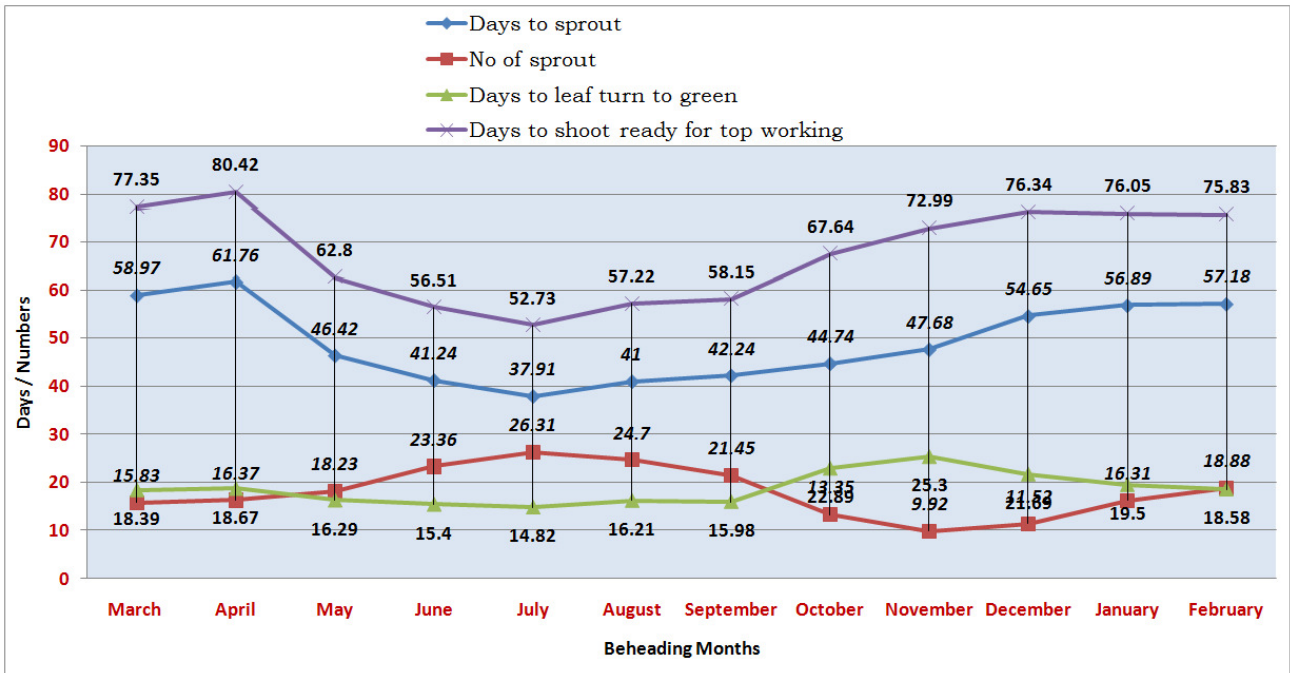


Fig.1. Effect of beheading months on growth of stock

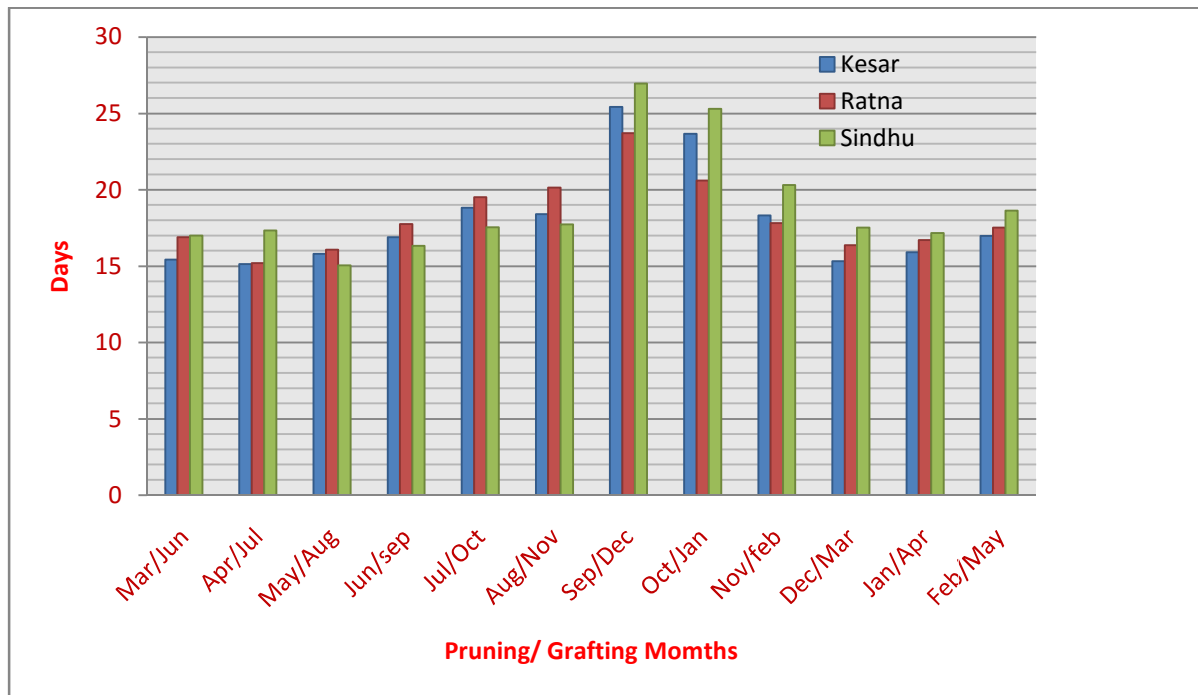


Fig.2. Average days required to sprouting of grafts

Table I: Effect of beheading / grafting months and scion variety on graft success and survival in MTW

Top working Details		Graft success % at 30DAG stage				Graft survival % at 90DAG stage			
Beheading Months	Grafting Months	Scion cultivars				Scion cultivars			
		Kesar	Ratna	Sindhu	Mean	Kesar	Ratna	Sindhu	Mean
Mar-10	Jun-10	72.39 (58.31)	60.87 (51.33)	71.09 (57.57)	68.11 (55.73)	11.09 (19.45)	7.93 (16.30)	8.62 (17.06)	9.21 (17.60)
Apr-10	Jul-10	78.06 (62.52)	71.12 (57.50)	73.75 (59.33)	74.31 (59.78)	23.86 (29.22)	14.78 (22.58)	16.52 (23.82)	18.39 (25.21)
May-10	Aug-10	85.41 (67.65)	80.88 (64.10)	87.76 (69.53)	84.68 (67.09)	19.28 (25.99)	16.64 (24.07)	22.60 (28.36)	19.50 (26.14)



Jun-10	Sep-10	75.29 (60.28)	74.43 (59.69)	77.62 (61.81)	75.78 (60.59)	20.28 (26.75)	18.39 (25.37)	22.31 (28.16)	20.32 (26.76)	
Jul-10	Oct-10	61.99 (51.94)	60.42 (51.04)	66.19 (54.46)	62.87 (52.48)	11.71 (20.01)	10.19 (18.55)	14.92 (22.71)	12.27 (20.42)	
Aug-10	Nov-10	61.15 (52.00)	54.44 (47.57)	64.94 (53.73)	60.18 (51.10)	25.06 (30.03)	20.55 (26.94)	27.30 (31.48)	24.30 (29.49)	
Sep-10	Dec-10	27.77 (31.79)	24.44 (29.58)	22.18 (28.09)	24.79 (29.82)	25.66 (30.39)	18.92 (25.77)	21.06 (27.29)	21.88 (27.82)	
Oct-10	Jan-11	45.00 (42.12)	31.19 (33.85)	25.82 (30.51)	34.00 (35.49)	42.40 (40.62)	27.09 (31.26)	23.44 (28.91)	31.00 (33.60)	
Nov-10	Feb-11	61.12 (51.43)	39.03 (38.66)	38.97 (38.58)	46.37 (42.89)	40.66 (39.62)	38.46 (38.32)	36.25 (37.02)	38.46 (38.32)	
Dec-10	Mar-11	61.37 (51.67)	38.99 (38.56)	44.52 (41.84)	48.29 (44.02)	40.62 (39.59)	35.40 (36.51)	30.38 (33.44)	35.47 (36.51)	
Jan-11	Apr-11	61.26 (51.51)	42.56 (40.72)	48.79 (44.29)	50.86 (45.51)	35.40 (36.51)	25.15 (30.07)	13.19 (21.29)	24.58 (29.29)	
Feb-11	May-11	52.32 (46.33)	21.72 (27.77)	39.77 (39.07)	37.94 (37.72)	21.59 (27.68)	17.71 (24.86)	20.13 (26.64)	19.81 (26.39)	
Mean		61.93 (52.29)	50.01 (45.03)	55.12 (48.23)		26.47 (30.49)	20.93 (26.72)	21.39 (27.18)		
		SE(+)	CD at 5%				SE(+)	CD at 5%		
Variety		0.67	1.96			Variety		0.29	0.87	
Month		1.34	3.91			Month		0.59	1.74	
Variety x Month		2.31	6.77			Variety x Month		1.03	3.01	

* Figures in parenthesis are arcsine value *DAG - Days After Grafting

Table II (a): Percent cumulative incidence of stem borer on monthly beheaded mango tree

Days After Beheading	Mango Beheading Months (2010-11)												Mean
	Mar-10	Apr-10	May-10	Jun-10	Jul-10	Aug-10	Sep-10	Oct-10	Nov-10	Dec-10	Jan-11	Feb-11	
30	-	-	-	-	-	-	-	-	-	-	-	-	-
60	-	-	-	-	-	-	5.33L	-	-	-	-	-	0.44L
90	4.17L	5.33L	12.00L	10.67L	18.67M	22.00M	20.33M	5.33L	-	-	-	-	8.21L
120	21.67M	45.33H	68.00H	33.34H	49.32H	42.67H	25.33M	5.33L	-	-	-	-	24.25M
150	45.83H	62.66H	74.66H	38.65H	49.32H	48.00H	25.33M	5.33L	-	-	-	-	29.15M
180	45.83H	62.66H	74.66H	38.65H	49.32H	48.00H	25.33M	5.33L	-	-	-	12.00L	30.15H
210	45.83H	62.66H	74.66H	38.65H	49.32H	48.00H	25.33M	5.33L	-	-	5.33L	12.00L	30.59H
240	45.83H	62.66H	74.66H	38.65H	49.32H	48.00H	25.33M	5.33L	-	6.67L	5.33L	12.00L	31.15H
270	45.83H	62.66H	74.66H	38.65H	49.32H	48.00H	25.33M	5.33L	-	6.67L	5.33L	12.00L	31.15H
300	45.83H	62.66H	74.66H	38.65H	49.32H	48.00H	25.33M	5.33L	4.17L	6.67L	5.33L	12.00L	31.50H
330	45.83H	62.66H	74.66H	38.65H	49.32H	48.00H	25.33M	5.33L	4.17L	6.67L	5.33L	12.00L	31.50H
360	45.83H	62.66H	74.66H	38.65H	49.32H	48.00H	25.33M	5.33L	4.17L	6.67L	5.33L	12.00L	31.50H

: No incidence (0.0%), L: Low incidence (1-15%), M: Medium Incidence (16-30%), H: High incidence (>30%)Cont.....

Table II (b): Percent cumulative incidence of stem borer on monthly beheaded mango tree

Days After Beheading	Mango Beheading Months (2011-12)												Mean
	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	
390	45.83	62.66	80.54	38.65	49.32	56.82	25.33	5.33	4.17	6.67	5.33	12.0	32.72
420	45.83	62.66	80.54	48.02	49.32	56.82	25.33	5.33	4.17	6.67	5.33	12.0	33.50
450	45.83	62.66	86.42	60.52	49.32	56.82	25.33	5.33	4.17	6.67	5.33	12.0	35.03
480	51.39	65.60	86.42	60.52	49.32	56.82	25.33	5.33	4.17	6.67	5.33	17.89	36.23
510	54.36	71.48	86.42	60.52	49.32	56.82	25.33	5.33	4.17	6.67	11.12	20.83	37.70
540	54.36	71.48	86.42	60.52	49.32	56.82	25.33	5.33	4.17	6.67	16.68	26.72	38.65
570	54.36	71.48	86.42	60.52	49.32	56.82	25.33	5.33	9.73	15.0	16.68	26.72	39.81
600	54.36	71.48	86.42	60.52	49.32	56.82	25.33	5.33	9.73	15.0	16.68	26.72	39.81
630	54.36	71.48	86.42	60.52	49.32	56.82	33.18	5.33	9.73	15.0	16.68	26.72	40.46
660	54.36	71.48	86.42	60.52	49.32	56.82	33.18	13.67	9.73	15.0	16.68	26.72	41.16
690	54.36	71.48	86.42	60.52	49.32	56.82	33.18	13.67	9.73	15.0	16.68	26.72	41.16
720	54.36	71.48	86.42	60.52	49.32	56.82	33.18	13.67	9.73	15.0	16.68	26.72	41.16



Table III: Percent Mortality of Beheaded Trees due to mango stem borer infestation during 2010-11 and 2011-12

Beheading Months	Mortality (%)		Pooled Mean
	2010-11	2011-12	
March-10	32.50 (34.51)	45.83 (42.57)	39.17 (38.67)
April-10	60.00 (51.12)	65.56 (54.37)	62.78 (52.40)
May-10	72.22 (63.23)	83.33 (70.20)	77.78 (62.03)
June-10	36.67 (36.92)	56.67 (49.20)	46.67 (43.03)
July-10	46.67 (43.06)	46.67 (43.06)	46.67 (43.07)
August-10	44.45 (41.26)	55.56 (48.23)	50.00 (44.98)
September-10	24.45 (29.13)	29.89 (32.76)	27.17 (31.37)
October-10	5.33 (7.86)	11.11 (16.06)	8.22 (16.41)
November-10	0.00 (0.00)	6.67 (8.85)	3.33 (7.48)
December-10	6.67 (8.85)	13.33 (17.70)	10.00 (18.18)
January-11	0.00 (0.00)	16.55 (19.69)	8.28 (12.00)
February-11	0.00 (0.00)	24.22 (28.96)	12.11 (14.74)
Mean	25.88 (45.96)	35.61 (62.67)	
SE(m)	5.75	7.05	4.37
C.D.	16.98	20.81	13.76

*Figures in parenthesis are arcsine value