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Research Article

RESPONSE OF PRUNING SEVERITY AND TIME OF PRUNING IN CUSTARD APPLE

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A R T I C L E I N F O

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A B S T R A C T

The experiment entitled effect of severity and time of pruning on growth, yield and quality of custard apple was carried out at Highway Block, CFR Station, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, during year 2016-17 with the objectives to the effect of different severity and time of pruning on growth, yield and quality of custard apple and to find out optimum severity and time of pruning for obtaining maximum yield and quality of custard apple. The pruning was done on main shoot, subsequent secondary and tertiary shoots from top to end on whole plant. Results revealed in respect to plant growth, plant volume, mean of plant spread, leaf area, was recorded significantly maximum in 30 cm pruning severity on 30th April.

Minimum number of days for flowering was recorded in shoots without pruning (70.18 days). Highest numbers of flowers per shoot (13.07) were registered in 30 cm of pruning severity and 30th April on time of pruning. In case of yield and fruit attributes the highest fruit set was registered (62.56%), highest numbers of fruits per tree (76.00), maximum fruit yield was obtained (16.40 kg), maximum fruit weight (234.34g), Maximum fruit diameter (9.65cm) in total soluble solids (19.43°B) and acidity (0.23 %) in 30 cm pruning severity on 30th April.

The effect of interaction between effect of severity and time of pruning on stem diameter, seed weight, splitting fruit and stoning fruit percentages was found non-significant.

INTRODUCTION

Custard apple (*Annona* squamosa L.) is tropical fruit crop, which belong to the family Annonaceae, having chromosome number 2n=14 and origin in tropical America. It is being cultivated in Philippines, West India, South Africa, Sri Lanka, Israel and Myanmar. Custard apple growing regions in India include Assam, Bihar, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Uttar Pradesh, Andhra Pradesh and Tamil Nadu. Approximately 55,000 hectares are dedicated to custard apple cultivation in India. Along with Maharashtra and Gurajat is another large custard apple growing state (Annon, 2014). In Maharashtra this fruit is mainly grown in the district Beed, Pune, Buldhana, Nagpur, Dhule, Aurangabad, Akola and Solapur. The climatic condition of Maharashtra is one of the most suitable for custard apple production in rainy season with minimum efforts and less expenditure. It is tolerant to drought, sandy loam soil but well structured clay loam soil is also suitable with good drainage. Also, no serious pests, diseases and disorders are found on this crop. Hence there is great scope to increase the area, production and productivity of custard apple. The custard apple tree is small, more or less shrub or tree, which sheds the leaves in winter. Young custard apple is vigorous and has poor precocity of bearing. The flowers are borne on current season growth (new emerging young shoots).

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Pruning in custard apple is one of the most important practice influencing the vigor, productivity and quality of fruits. Pruning improves not only the fruit quality but it also required at early stage to build up a strong framework in order to increased fruit bearing area of tree become weak and both fruit size and quality impaired. Thus regular annual pruning at bearing stage may help to induced good healthy shoots which will provide maximum fruit bearing area and good quality fruits. (Bajpai *et al.,*1973). Pruning is essential to develop a good crown and better yields over a long period of time. Without pruning, the plants become bushy and their bearing efficiency comes down. Hence, timely removal of misplaced limbs is necessary to build a strong framework. Selective and mild pruning of deadwood and very old branches is necessary to avoid congestion and encourage well-spaced branching. Yellowing of leaves starts as the harvesting season of fruits ends. The leaves begin to drop with the onset of winter and fresh growth occurs in spring. Therefore, considering bottleneck in the cultivation of custard apple, it is necessary to standardize the pruning levels and time of operation to develop for increasing the pollen viability, fruit set, yield and yield contributing characters and quality traits in custard apple under prevailing climatic conditions of Maharashtra.

MATERIALS AND METHODS

The experiment entitled "Effect of severity and time of pruning on growth, yield and quality of Custard Apple

(Annona squamosa L.*)* will be conducted at Highway Block, CRF unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the year 2016-2017. The experiment was laid out in Factorial Randomized Block Design with two different treatments first are pruning *Viz.*, P_1 -15 cm, P_2 -30 cm, P_3 -45 cm and P_4 (control) and second are D_1 -15th April, D_2 -30th April, D_3 -15th May with twelve treatment combination which were replicated three times

Treatments details

Factor A- Pruning severity

1. $P_1$15 (cm)
2. P_2 30 (cm)
3. P_3 45 (cm)
4. P_4 Control (No pruning)

Factor B- Pruning Dates

1. D_1 15 April
2. D_2 30 April
3. D_3 15 May

Treatment combination

P_1 D_1	P_2 D_1	P_3 D_1	P_4 D_1
P_1 D_2	P_2 D_2	P_3 D_1	P_4 D_2
P_1 D_3	P_2 D_3	P_3 D_1	P_4 D_2

RESULTS AND DISCUSSION

The result obtained from the present investigation as well as relevant discussion have been summarized under following sub heads and given in Table 1 and 2.

Plant Height (m)

The data presented in table 1 showed the significant results due to severity of pruning on growth and flowering parameters of custard apple. Effect of severity of pruning on the plant height was found to be significant treatment P_2 produced significantly maximum plant height (2.92 m) which was at par with treatment P_1 (2.84 m) and lowest plant height (2.53 m) was recorded in P_4 (control) treatment.

In respect to effect of pruning time on plant height was recorded the significant differences among all the treatments. The significantly maximum plant height (2.92 m) was found in treatment D_2 (30th April) which were found statistically at par with treatment D_3 (2.62 m) However, lowest plant height (2.59 m) was recorded in treatment D_1 (15th April).

In respect to interaction effect of time and severity levels of pruning on plant height was found to be non significant. It is might be due to pruning shift the allocation of metabolites from rainy season crop in favors of increased vegetative growth due to flower and fruit set removal as a result of pruning. The result of present finding are agreement with the finding of Singh (2001), Kumar and Rattanpal (2010) in guava, Marlon *et al*. (2013) in custard apple.

Plant Spread (m)

The data presented in Table 1 indicated that, effect of severity on the plant spread it was found to be significant in treatment P_2 produced maximum plant spread (2.81 m) which was followed by treatment P_1 (2.72 m) However, lowest plant spread (2.54 m) was recorded with P_4 (control) treatment.

In respect to effect of pruning time on plant spread significantly the maximum plant spread (2.74 m) was found in treatment D_2 (30th April) which were followed by with treatment D_3 (2.73 m) and However, lowest plant spread (2.57 m) was recorded in treatment D_1 (15th April).

In respect to interaction effect due to time and severity levels of pruning on plant height was found to be non significant. The result of present finding are agreement with the finding of Lal and Mishra, (2008) in mango, Kumar and Rattanpal, (2010) in guava.

Plant Volume (m^3)

The data presented in Table 1 indicated that, effect of severity on the plant volume was found to be significant treatment P_2 produced significantly maximum plant volume (18.22 m^3) which were at par with treatment P_1 (17.67 m^3) and lowest plant volume (14.25 m^3) was recorded with P_4 (control) treatment.

In respect to effect of pruning time on plant volume significantly the maximum plant volume (16.83 m^3) was found in treatment D_2 (30th April) which was found statistically at par with treatment D_3 (16.09 m^3) However, lowest plant volume (15.46 m^3) was recorded in treatment D_1 (15th April). In respect to interaction effect due to time and severity levels of pruning on plant volume was found to be non-significant. It might be due to fact that pruned trees were unable to make up the loss of vegetative growth caused by severe pruning treatments in this short period. (Kumar and Rattanpal, 2010). The results of present findings are in agreement with the findings of Ingle *et al.* (1999) in acid lime, Kaur and Dhaliwal (2001) and Dalal *et al.* (2004) in guava.

Leaf area (m^2)

The data presented in Table 1 indicated that, the leaf area was significantly influenced by the severity levels treatment P_2 (30cm) produced significantly maximum leaf area (39.12 cm^2) which was at par with treatment P_3 (38.49 cm^2), P_1 (37.58cm) However, minimum leaf area (34.33 cm^2) was recorded in treatment P_4 (control).

In respect to effect of pruning time on plant leaf area was significantly maximum (39.18 cm^2) recorded in treatment D_2 (30th April) which was found at par with treatment D_1 (36.54 cm^2) and treatment D_3 (15th May) which was recorded minimum leaf area (36.43 cm^2).

In respect to interaction effect due to time and severity of pruning on leaf area was found non significant. The higher leaf area might be due to more uptake of nutrients from soil and accumulation in leaf tissues which enhances the leaf area. The result of present finding are agreement with the finding of Pilania *et al*. (2010) and Shaiva *et al* (2015) in guava.

Number of days required for first flowering

The data presented in Table 1 indicated that, the number of days required for first flowering was significantly minimum number of days for flowering was recorded in treatment P_4 (70.18 days) and maximum number of days required for first flowering was required in treatment P_3 (91.73 days). In respect to effect of pruning time on number of days required for first flowering significantly maximum (87.12) days required to flowering in treatment D_1 (15th April) which was found at par D_2 (78.50) and minimum days (78.13) required to flowers in

treatment D_3 (15th May). In respect to interaction effect due to time and levels of severity of pruning on number of days required for first flowering was found non significant. This is might be due to pruning early flowering, it was also observed that more number of flowers per branch result if pruning is practiced in first week of may. The results of present findings are in accordance with the findings of Singh and Sandhu (1984) and Gupta *et al.* (1990) in ber, Dhaliwal and Kaur (2003) in guava and Naseem *et al*. (2016) in ber.

Number of Flower per Shoot

The data presented in Table 1 indicated that, the number of flowers per shoot was significant effect due different severity of pruning. The pruning severity in treatment P_2 (30 cm) produced maximum number of flowers per shoot (13.07) which was found at par with treatment P_3 (11.17) and P_1 (10.96) However, minimum number of flowers per shoot (10.01) was recorded under control treatment P_4 (control).

In respect to effect of pruning time on number of flower per shoot significantly maximum flowers per shoot (11.76) were found with treatment D_2 (30th April) and at par with the treatment D_3 (11.4) However, time of pruning which was D_1 (15th April) showed minimum flowers per shoot (10.74).

In respect to interaction effect might be due to time and severity of pruning on number of flowers per shoot was significantly was maximum number of flower found at treatment combination P_2D_2 (13.07), which is followed by P_2D_3 (13.7) while minimum was observed at P_4D_1 (9.49). Severe pruning had much adverse effect on flowering than mild pruning. Reduction in number of flowers in severely pruned branches due to loss of potential bearing wood of tree. This might be reason for promoted number of flowers in mild pruned branches. The result of present finding are agreement with the finding of Sheikh and Hulmani (1993), Jadhao *et al*. (2002) in guava and Mohamed (2010) in custard apple.

Fruit set (%)

The data presented in Table 1 indicated that, the fruit set was significant effect due different severity of pruning. Fruit set was found significantly maximum (78.77 %) in treatment P_2 (30 cm) which was at par with treatment P_1 (77.69) while minimum fruit set recorded in treatment P_4 (control) (72.09 %).

In respect to effect of pruning time on fruit set significantly maximum fruit set was found in D_2 (79.39%) were found with (30th April) which was found at par with D_1 (75.28 %) while minimum fruit set was in D_3 (75.01 %).

In respect to interaction effect due to time and severity of pruning on fruit set percentages was found non-significant. This might be attributes to fact that, early pruned plants flowered 48 earlier in time when climatic conditions were favorable but as the pruning was delayed the flowering also delayed which coincided with the heavy rains that caused flower drop and fruit drop which ultimately resulted in less fruit percentage. The results of present findings are in agreement with the findings of Singh and Sandhu (1984) and Ali *et al.*(2009) in guava.

Number of Fruit per plant

The data presented in Table 1 indicated that, effects of severity on number of fruits per plant harvested was found significantly maximum number of fruits per plant harvested (76.00) in treatment P_2 (30 cm), which was recorded at par with P_3 (70.00) and P_1 (63.33) However, minimum number of fruits per plant (62.00) harvested in treatment P_4 (control). In respect to effect of pruning time on number of fruit per fruit significant maximum number of fruits per plant harvested (73.00) were found in treatment D_2 (30th April) which was at par with D_1 (66.50) while minimum (64.00) in treatment D_3 (15th May).

In respect to interaction effect due to time and severity of pruning on number of fruit per plant shoot was found non-significant. The useful effect of moderate severity was due to the effect that, it increased the efficiency of metabolic and physiological processes of plants and thus encouraged the yield and quality of the fruit Kumar and Rattanpal (2010). The results of present findings are in agreement with the findings of Chandra and Govind (1995), Mohamed *et al.* (2010) in custard apple and Ali *et al.* (2009) in guava.

Table 1 Effect of Severity and Time of Pruning on Growth, Yield and Quality of Custard Apple

Treatment	Plant heights (m)	Plant spread (m)	Plant volumes (m^3)	Leaf area (cm^2)	No days required flowering	No of flower / shoot	Fruit set (%)	No. of fruit / plant
Pruning severity								
P_1 – 15 (cm)	2.84	2.72	17.67	37.58	91.73	10.96	77.69 (61.81)	63.33
P_2 - 30 (cm)	2.92	2.81	18.22	39.12	85.84	13.07	78.77 (62.56)	76.00
P_3 - 45 (cm)	2.54	2.64	14.37	38.49	77.26	11.17	77.68 (61.80)	70.00
P_4- no pruning	2.53	2.54	14.25	34.33	70.18	10.01	72.09 (58.11)	62.00
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.03	0.03	0.19	0.28	1.05	0.08	0.40	0.96
CD at 5%	0.09	0.05	0.56	0.83	3.07	0.24	1.18	2.82
Pruning Dates								
D_1 15 April	2.59	2.57	15.46	36.54	87.12	10.74	75.28 (60.18)	66.50
D_2 30 April	2.92	2.74	16.83	39.18	78.5	11.76	79.39 (63.00)	73.00
D_3 15 May	2.62	2.73	16.09	36.43	78.13	11.4	75.01 (60.00)	64.00
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.03	0.02	0.17	0.24	0.91	0.07	0.35	0.86
CD at 5%	0.08	0.04	0.49	0.72	2.66	0.21	1.02	2.44
Pruning Severity * Pruning Dates								
P_1D_1	2.88	2.82	17.38	36.9	97.7	11.42	78.2 (62.16)	62
P_2D_1	2.76	2.83	17.84	37.55	96.72	11.2	75.51 (60.33)	71
P_3D_1	2.24	2.58	14.1	36.99	78.36	10.86	77.62 (61.76)	73
P_4D_1	2.46	2.03	12.54	34.7	75.7	9.49	75.28 (60.18)	60
P_1D_2	2.75	2.56	17.02	38.54	87.43	10.79	79.3 (62.93)	66
P_2D_2	3.22	2.85	19.49	40.69	81.79	14.3	82.59 (65.33)	81
P_3D_2	3.06	2.73	14.93	40.47	75.94	11.24	78.3 (62.23)	75
P_4D_2	2.63	2.81	15.89	37	68.84	10.72	77.37 (61.59)	70
P_1D_3	2.88	2.78	18.63	37.3	90.05	10.67	75.57 (60.37)	62
P_2D_3	2.78	2.74	17.34	39.12	79	13.7	78.21 (62.17)	76
P_3D_3	2.32	2.62	14.09	38	77.47	11.42	77.12 (61.42)	62
P_4D_3	2.51	2.77	14.32	31.3	66.01	9.81	69.13 (60.00)	56
F Test	NS	NS	NS	NS	NS	SIN	NS	NS
SE (m)±	0.06	0.05	0.36	0.49	1.82	0.14	0.70	1.66
CD at 5%	--	--	--	--	--	0.41	--	--

Note-Figures in parenthesis denote the arc sign transformations value.

Number of Seeds per Fruit

The data presented in Table 2 indicated that, effects of severity on number seeds per fruits was found significantly maximum in treatment P_2 (30 cm) recorded maximum number of seeds (36.67) which was found at par with treatment P_1 (34.33) and P_3 (31.67) However, minimum number of seeds (30.00) in treatment P_4 (control).

In respect to effect of pruning time on number of seeds per fruit significantly, maximum number of seeds (35.50) found in treatment D_2 (30^{th} April) which was found at par with treatment D_1 (33.50). However, minimum number of seeds per fruit (33.50) was found in treatment D_3 (15 May).

In respect to interaction effects due to time and severity levels on seed per fruit content was found non-significant. This might be due to fact that, better availability of food material to all plant parts and activation of enzymes which act as catalase activity and chlorophyll content of leaves increase in carbohydrates synthesis resulted increased yield and quality of fruit. (Singh and Singh, 2001). The results of present findings are in agreement with the findings of Dhaliwal and Kumar (2003) in guava.

Fruit Yield per Plant (Kg/Tree)

The data presented in Table 2 indicated that, effects of severity on fruit yield per plant was found significantly maximum in treatment P_2 (30 cm) produced significantly maximum yield per plant (16.40 kg/plant) which was found at par with treatment P_3 (15.10 kg/plant). Whereas, minimum yield per plant (11.93 kg/plant) was recorded in treatment P_4 (control).
In respect to effect of pruning time on fruit yield significantly maximum yield per plant (14.88 kg/plant) was recorded in treatment D_2 (30^{th} April), followed by D_3 (14.55 kg/plant). Whereas, minimum yield per plant (12.95 kg/plant) was noted in treatment D_1 (15^{th} April).

In respect to interaction effects due to time and severity of pruning levels on seed weight per fruit content was found non-significant.

Fruit Weight (gm)

The data presented in Table 2 indicated that, effects of severity on fruit weight was found significantly maximum fruit weight recorded in treatment P_2 (234.34 gm) which were followed by with treatment P_3 (225.33 gm) and minimum fruit weight in treatment P_4 (208.33 gm).

In respect to effect of pruning time showed significant effect on fruit weight. it was observed that, the highest fruit weight was observed with (30^{th} April) (229.5 gm) which was found at par with treatment D_1 (217.5 gm) while lowest in D_3 (217.00 mg) was observed in treatment (15^{th} May).

In respect to interaction effect to time and severity of pruning on fruit weight was found non-significant.

Length of Fruit (Cm)

The data presented in Table 2 indicated that, effects of severity on fruit length was found significantly maximum fruit length was recorded in treatment P_2 (7.81 cm) which is at par with treatment P_1 (7.45 cm) while minimum length of fruit (5.56 cm) was observed in P_4 (control). In respect to effect of pruning time on length of fruit was found significant. The D_2 (30^{th} April) treatment produced significantly maximum length of fruit (7.81 cm) which was followed by treatment D_3 (7.42 cm). However, minimum length of fruit (6.02 cm) was recorded from D_1 (15^{th} May) treatment.

In respect to effect of interaction effect due to time and severity of pruning levels on length of fruit was found non-significant.

Fruit Diameter (Cm)

The data presented in Table 2 indicated that, effects of severity on fruit diameter was found significantly maximum fruit diameter was recorded in treatment P_2 (9.65 cm) which was followed by with treatment P_1 (8.42 cm) while minimum fruit diameter of fruit (7.45 cm) was recorded in treatment P_4 (control).

In respect to effect of pruning time on diameter of fruit significant maximum diameter of fruit (9.18 cm) was found in treatments D_2 (30^{th} April), which was recorded at par with treatment D_3 (8.48 cm). However, minimum diameter of fruit (7.54 cm) was found in treatment D_1 (15 April).

In respect to effect of interaction effect due to severity and time of pruning levels on diameter of fruit was found non-significant. In present studies large sized fruits were obtained in medium pruning treatment, because of age group difference within the treatment. Hence, response to heavy pruning may be less pronounced. The results of present findings are in agreement with the findings of Dalal *et al.* (2004) and Jadhao *et al*. (2002) in guava.

Total soluble solids (^0B)

The data presented in Table 2 indicated that, effects of severity on total soluble solids was found significantly maximum total soluble solids (19.43°B) were found in treatment P_2 (30 cm) which were followed by with treatment P_1 (18.73 ^{0}B) and P_4 (control).

In treatment P_3 which showed minimum total soluble solids (16.57 ^{0}B) and in respect to effect of time of pruning recorded the treatment D_2 (30^{th} April) recorded significantly maximum total soluble solids (18.64B^0), which were followed by with treatment D_1 (18.36 B^0). However, minimum total soluble solids (18.00 B^0) were recorded under D_3 (15 May).

In respect to interaction effect due to severity and time of pruning levels on total soluble solid was found non-significant. The result of present findings are in arrangement with the finding of Bagchi *et al.* (2008) in guava, Mohamed *et al*. (2010) in custard apple and Shiva *et al.* (2015) in guava.

Titratable Acidity (%)

The data presented in table 2 showed that, significantly maximum acidity (0.23%) was recorded in treatment P_2 (30 cm) which were followed by with treatment P_3 (0.21%), P_1 (0.18%). However, treatment which showed minimum acidity (0.17%) was found in treatment P_4 (control).

In respect to effect of time of pruning on titratable acidity significantly was found in D_2 (30^{th} April) produced significantly maximum Ascorbic acidity (0.22%) which was found at par with D_3 (0.19) whereas, minimum Titratable acidity (0.18) was recorded under treatment D_1 (15^{th} April).
In respect to interaction effect due to severity and time of pruning levels on titratable acidity (%) was found non-significant

Table 2 Effect of Severity and Time of Pruning on Growth, Yield and Quality of Custard Apple

Treatment	No of seed / fruit	Fruit yield (kg/ tree)	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm)	Seed weight (g)	TSS (^{0}B)	Acidity (%)
Pruning severity								
P_1 – 15 (cm)	34.33	13.07	217.33	7.45	8.42	10.96	18.73	0.18
P_2 - 30 (cm)	36.67	16.40	234.34	7.81	9.65	13.07	19.43	0.23
P_3 - 45 (cm)	31.67	15.10	225.33	7.51	8.08	11.17	18.61	0.21
P_4- no pruning	30.00	11.93	208.33	5.56	7.45	10.01	16.57	0.17
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.35	0.21	0.78	0.16	0.15	0.08	0.16	0.01
CD at 5%	1.03	0.62	2.28	0.48	0.45	0.24	0.48	0.02
Pruning Dates								
D_1 15 April	33.50	12.95	217.5	7.42	7.54	10.96	18.36	0.18
D_2 30 April	35.50	14.88	229.5	7.81	9.18	13.07	18.64	0.22
D_3 15 May	30.50	14.55	217.0	6.02	8.48	11.17	18.00	0.22
F Test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m)±	0.30	0.18	0.67	0.14	0.13	0.08	0.14	0.01
CD at 5%	0.89	0.54	1.97	0.41	0.39	0.24	0.41	0.03
Pruning Severity * Pruning Dates								
P_1D_1	33	11.5	219	7.89	7.55	0.026	19.04	0.17
P_2D_1	37	14.7	223	6.63	8.59	0.03	19.29	0.21
P_3D_1	35	13.9	212	7.65	7.54	0.111	18.39	0.21
P_4D_1	29	11.7	217	7.51	6.48	0.032	16.71	0.14
P_1D_2	36	13.7	215	7.74	8.69	0.026	18.99	0.19
P_2D_2	37	17.7	246	8.09	10.21	0.03	20.7	0.24
P_3D_2	34	16.5	232	9.84	9.59	0.111	18.3	0.23
P_4D_2	35	11.6	225	5.58	8.24	0.032	16.58	0.22
P_1D_3	34	14	218	6.72	9.03	0.024	18.15	0.19
P_2D_3	36	16.8	235	8.72	10.15	0.034	18.29	0.24
P_3D_3	26	14.9	232	5.05	7.1	0.022	19.15	0.18
P_4D_3	26	12.5	183	3.6	7.64	0.023	16.41	0.15
F Test	NS	NS	NS	NS	NS	NS	NS	NS
SE (m)±	0.61	0.31	1.34	0.28	0.26	0.015	0.28	0.02
CD at 5%	--	--	--	--	--	--	--	--

Note-Figures in parenthesis denote the arc sign transformations value.

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