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Management of buckeye rot of tomato caused by *Phytophthora nicotianae* var. *parasitica* under mid-hill conditions of Himachal Pradesh

Gurpreet Kaur and DK Banyal

Abstract
Buckeye rot of tomato caused by *Phytophthora nicotianae* var. *parasitica* (Dastur) Waterhouse is one of the most serious disease of tomato throughout the world and causes high yield losses. For the management of the disease different botanicals, biocontrol agents and fungicides were evaluated against the pathogen under *in vitro*. The fungicides were also evaluated under field conditions during 2017 and 2018. Aqueous extract of *Melia azedarach* @ 20% gave maximum growth inhibition (70.00%) of *P. nicotianae* var. *parasitica* under *in vitro.* Among 8 fungicides evaluated *in vitro*, iprovalicarb 5.5%+ propineb 61.25% WP (Melody Duo 66.75 WP) at 100 µg/ml gave 100 per cent mycelial growth inhibition. Evaluation of fungicides under field conditions showed that three foliar application at 10 days interval of iprovalicarb 5.5%+ propineb 61.25% WP (@ 0.25%) resulted in maximum (54.72%) disease control with 81.51 per cent increase in yield over check.

Keywords: Tomato, buckeye rot, *Phytophthora nicotianae* var. *parasitica* management, botanicals

Introduction
Tomato buckeye rot caused by *Phytophthora nicotianae* var. *parasitica* (Dastur) Waterhouse is a vicious disease of tomato in many parts of the world. This pathogen grows vigorously in warm, wet conditions and lives in the soil (Hanson 2014). Symptoms of the pathogen are characterized by a bull's eye pattern of dark brown rotting on the tomato fruit and affect fruits that are close to or lying on the soil (Cerkauskas 2004) [4]. Buckeye rot incidence may go upto 90 per cent under high humidity and good rainfall (Gupta and Thind 2006). Losses from 18 to 35 per cent were recorded due to buckeye rot (Sokhi and Sohi 1982) [24]. Dodan *et al*. (1995) [6] recorded disease incidence of 65 per cent due to fruit rot disease in ripe tomatoes from Himachal Pradesh. Chemicals are inevitable means of plant disease control, which form the protective covering on the host surface or exterminate the established infections thereby reducing the production of secondary inoculum and ultimately restricting the pace of progress of the disease. Disease management through foliar application of chemicals like mancozeb, copper fungicides and captafol which have been reported to be most effective could also reduce disease incidence by about 50 per cent and are likely to be inadequate to avoid yield losses under epiphytotic conditions (Dodan *et al*. 1992) [7]. The chemical treatments to control this disease have turn into costly affairs. The biocontrol of soil borne diseases has added an advantage in hill ecosystem as various biocontrol agents like *Trichoderma* species and fluorescent *Pseudomonas* have been reported effective against the soil borne diseases. At present there is a need to build and utilize the effective low cost, ecofriendly technologies and effective fungicides in the crop production programme. The use of botanicals and bioagents has a good prospect in future as it can lead to a high cost benefit ratio. Keeping in view, the present investigation was undertaken to evaluate the botanicals, fungicides and bioagents against *Phytophthora nicotianae* var. *parasitica*.

Materials and Methods
In vitro evaluation of botanicals
The aqueous extracts of botanicals namely *Ocimum sanctum*, *Melia azedarach*, *Lantana camara*, *Eucalyptus* sp. and *Eupatorium adenophorum* were evaluated *in vitro* against the pathogen under sterilized conditions by 'Poisoned Food Technique'. Leaves of all the botanicals were collected from the surroundings of Palampur and were oven dried by

spreading them on the shelves of hot air oven over two to three layered blotting sheets at 50 °C for 5 to 6 hours for two to three days. To obtain fine dry powder, the respective plant material was ground in a blender after drying. Sufficient powdery biomass was stored in paper bags (tassel bags) at room temperature for further use. Fifty gram fine powder of each botanical was soaked in 100 ml of sterilized distilled water (1:2 *w/v*) in 500 ml conical flask for overnight. Next day, the extract obtained was filtered through a double layer of muslin cloth and twice through Whatman filter paper to get clear filtrate. Finally, the filtrate thus obtained was used as stock solution (Krishan 2014) [17].

Desired concentrations of botanicals (5, 10, 15 and 20%) were obtained from the stock solution through serial dilution with distilled water. These concentrations were mixed carefully with equal quantity of double strength sterilized PDA medium and poured aseptically in sterilized Petri plates to get test concentrations of 5, 10, 15 and 20 per cent. Medium mixed with equal quantities of sterilized distilled water without any treatment used as control. From the margin of an actively growing colony, with the help of cork borer, mycelial bits of 5 mm in diameter were cut and placed in the centre of media plates. Of each treatment three replications were kept. These plates were then incubated at 25±1 °C. Regular observations were made and finally colony diameter was measured after 7 days when the control plates were completely covered by the pathogen. The per cent inhibition over control was calculated by using the formula proposed by McKinney (1923) [18].

***In vitro* evaluation of bio-control agents**

To determine the antagonistic potential of biocontrol agents against *P. nicotianae* var. *parasitica*, the matching method between the antagonist and phytopathogen described by Dennis and Webster (1971) was used. The antagonistic activity of four biocontrol agents *viz., Trichoderma koningii* (DMA-8), *Trichoderma koningii* (JMA-11), *Trichoderma harzianum* (SMA-5) and *Trichoderma viride* was tested against *P. nicotianae* var. *parasitica* on potato dextrose agar medium by using dual culture technique (Huang and Hoes 1976). Mycelial bits of 5 mm in diameter were cut with the help of cork borer from the margin of an actively growing colony and placed at one end of Petri plate having solidified PDA medium. Similarly, mycelial disc (5mm) of antagonist was also placed at the other end of Petri plate in such a way that the distance between the pathogen and the bioagent remain about 7 cm. The plates containing potato dextrose agar medium inoculated with pathogen alone served as control. Three replications were maintained in each treatment. The plates were incubated at 25±1 °C. Observations on mycelial growth of test pathogen were recorded and per cent inhibition was calculated by the formula proposed by McKinney (1923) [18].

Chemical management

(i) *In vitro* evaluation of fungicides

Three non-systemic fungicides *viz.,* copper-oxychloride 50WP (Blitox-50), mancozeb 75WP (Indofil M-45) and propineb 72WP (Antracol), one systemic fungicide i.e. azoxystrobin 23% SC (Mirador) and four coordinated fungicides *viz*., cymoxanil 8%+ mancozeb 64% WP (Curzate 72 WP), iprovalicarb 5.5%+ propineb 61.25% WP (Melody Duo 66.75 WP), metalaxyl-M 4%+ mancozeb 64%WP (Ridomil Gold) and famoxadone 16.6%+ cymoxanil 22.1%SC (Equation pro) were evaluated against the pathogen through Poisoned Food Technique (Falck 1907) [8] at concentrations 50, 100, 250, 500, 750, 1000, 1500 and 2000 ppm in Completely Randomized Design (CRD) to study the inhibitory effect of these fungicides on mycelial growth of *P. nicotianae* var. *parasitica.* Each treatment was replicated thrice having 3 Petri plates each. The inoculated plates were incubated at 25±1ºC.

From the margin of an actively growing colony mycelial bits of 5 mm in diameter were cut with the help of cork borer and placed in the centre of media plates. A control treatment in which only plain sterilized distilled water was added to double strength medium was also kept. Regular observations on any type of fungal growth were made and finally colony diameter was measured after 7 days, when the control plates were completely covered by the growth of pathogen and per cent mycelial inhibition was determined as proposed by McKinney (1923) [18].

(ii) Field evaluation of fungicides

Field experiment was laid out at the experimental farm of the Department of Plant Pathology, CSKHPKV, Palampur in a Randomized Block Design (RBD) during 2017 and 2018, to study the effect of fungicides as foliar spray on the management of buckeye rot of tomato. Each treatment was replicated thrice. Plants of susceptible cultivar "Tomato Palam Hybrid-1" were transplanted with row to row and plant to plant spacing of 60 and 60 cm, respectively. All the 8 fungicides evaluated under *in vitro* were also evaluated in field individually as foliar spray.

At 10 days interval, three sprays of each fungicide were given individually. The first spray was given at the first appearance of the disease. Plants sprayed with water served as control. Data on disease incidence before each spray and 10 days after the last spray was recorded. Data on fruit yield were also recorded as kg/plot and converted into q/ha. Data on disease incidence and yield were pooled and per cent disease incidence, disease control and yield increase were calculated.

Results and Discussion

***In vitro* efficacy of botanicals**

In vitro testing of aqueous extracts of botanicals namely *Ocimum sanctum, Melia azedarach, Lantana camara, Eucalyptus* sp. and *Eupatorium adenophorum* revealed that out of five botanicals only *Lantana camara* gave mycelial inhibition (5.93%) at 5 per cent, while other botanicals were found ineffective at this concentration. At 10 per cent, *Eucalyptus* sp. gave 20 per cent mycelial inhibition followed by *Ocimum sanctum, Lantana camara* and *Melia azedarach* which provided 15.56, 10.37 and 10.00 per cent mycelial growth inhibition, respectively. *Melia azedarach* was found highly effective with 52.22 per cent mycelial inhibition followed by *Eucalyptus* sp. which showed 32.22 per cent mycelial inhibition at 15 per cent concentration. At 20 per cent, *Melia azedarach* was found most effective with 70.00 per cent mycelial inhibition whereas, *Eupatorium adenophorum* was found least effective with 25.56 per cent mycelial inhibition. *Eucalyptus* sp., *Ocimum sanctum* and *Lantana camara* provided 54.44, 48.89 and 41.85 per cent mycelial inhibition, respectively at 20 per cent concentration. The results has been shown in table 1.

Table 1: *In vitro* evaluation of aqueous extracts of botanicals against *Phytophthora nicotianae* var. *parasitica*

Botanical	Mycelial growth (mm) at different concentration (%)				Mycelial inhibition (%) at different concentration(%)			
	5	10	15	20	5	10	15	20
Ocimum sanctum	90.00	76.00	67.00	46.00	0.00	15.56	25.56	48.89
Melia azedarach	90.00	81.00	43.00	27.00	0.00	10.00	52.22	70.00
Lantana camara	84.67	80.67	64.67	52.33	5.93	10.37	28.15	41.85
Eucalyptus sp.	90.00	72.00	61.00	41.00	0.00	20.00	32.22	54.44
Eupatorium adenophorum	90.00	81.67	70.67	67.00	0.00	9.26	21.48	25.56
Control	90.00	90.00	90.00	90.00	-	-	-	-
CD (p=0.05)	0.42	2.03	2.03	1.84				

The effectiveness of botanicals was also described by Patel and Patel (1999) who reported that aqueous leaf extracts (10%) of *Ocimum sanctum* and *Eucalyptus citrodiora* were highly inhibitory (84.8-86.5% inhibition) against *P. parasitica* var. *nicotianae*, whereas extracts of *Clerodendron inerme*, L. *camara* and *Nicotianae nudicaulis* moderately inhibited (55-62.7%) the mycelial growth. Karegowda *et al*. (2009) [15] studied effect of aqueous leaf extracts (10%) of 25 plant species against *P. parasitica* var. *nicotianae* under *in vitro* and reported that extracts of *O. sanctum* inhibited maximum growth of 86.5 per cent followed by *E. citriodora* (85.8%), *Piper betle* (84.8%) whereas, *Anethum graveolens* was least effective with 6.4 per cent growth.

***In vitro* efficacy of bio-control agents**

Four biocontrol agents *viz.*, *Trichoderma koningii* (DMA-8), *Trichoderma koningii* (JMA-11), *Trichoderma harzianum* (SMA-5) and *Trichoderma viride* were tested *in vitro* for their antagonistic activity against *P. nicotianae* var. *parasitica.* Data on per cent inhibition of mycelial growth were recorded and presented in table 2. Data revealed that the tested biocontrol agents provided 22.22 to 53.42 per cent mycelial inhibition of the pathogen. Maximum mycelial growth inhibition (53.42%) was exhibited by *Trichoderma koningii* (DMA-8) followed by *Trichoderma koningii* (JMA-11) which showed 39.74 per cent inhibition. *Trichoderma harzianum* (SMA-5) gave 26.92 per cent inhibition. Minimum mycelial inhibition i.e. 22.22 per cent among all the bioagents was in case of *T. viride.*

Table 2: *In vitro* evaluation of biocontrol agents against *Phytophthora nicotianae* var. *parasitica*

Bioagents	Mycelial growth (mm)	Mycelial inhibition (%)
Trichoderma koningii (DMA-8)	36.33	53.42
Trichoderma koningii (JMA-11)	47.00	39.74
Trichoderma harzianum (SMA-5)	57.00	26.92
Trichoderma viride	60.67	22.22
Control	78.00	-
CD (p=0.05)	1.96	-

Hence, *T. koningii* (DMA-8) was superior to all others in inhibiting mycelial growth (53.42%), followed by *Trichoderma koningii* (JMA-11) which exhibited 39.74 per cent mycelial growth inhibition. The *in vitro* growth inhibition in presence of *Trichoderma* spp. could be attributed to competition, antibiosis and mycoparasitism (Shalini and Kotasthane 2007) [21].

The present findings are in agreement with Karegowda *et al*. (2009) [15] who reported that in dual cultures, *T. harzianum* was found to engulf *P. nicotianae* var. *parasitica* within 7 days of incubation. Jagtap *et al*. (2012) [13] observed that *T. harzianum* resulted in minimum mean colony diameter (7.73 cm^2) and highest inhibition (87.85%) of mycelial growth of *P. nicotianae* over untreated control followed by *T. viride* and *T. koningii* which gave mean colony diameter of 9.95 cm^2& 14.15 cm^2 and mean mycelial inhibition of 84.36 and 77.76 per cent, respectively. Krishan (2014) [17] reported that *T. koningii* (DMA-8) resulted in highest per cent inhibition i.e. 51.93 per cent followed by *T. koningii* (JMA-11), *T. harzianum* (SMA-5) and *T. harzianum* (JMA-4) causing 44.58, 39.53 and 9.53 per cent inhibition, respectively.

***In vitro* efficacy of fungicides**

Under *in vitro* at 50 µg/ml, among all the fungicides iprovalicarb 5.5%+ propineb 61.25% WP at 50 µg/ml was found most effective as it provided 86.11 per cent inhibition of mycelial growth, followed by mancozeb 75WP which provided 70.18 per cent inhibition of mycelial growth. At 100 µg/ml iprovalicarb 5.5%+ propineb 61.25%WP gave 100 per cent inhibition of mycelial growth followed by metalaxyl-M 4%+ mancozeb 64%WP and mancozeb 75WP which showed 81.48 and 75.37 per cent mycelial inhibition at the same dose of fungicide, respectively. At 250 µg/ml, metalaxyl-M 4%+ mancozeb 64%WP completely inhibited the mycelial growth followed by propineb 72WP with 85.00 per cent inhibition of mycelial growth at the same dose of fungicide. Azoxystrobin 23% SC was found least effective at 250 µg/ml this concentration with only 17.22 per cent mycelial inhibition (Table 3).

At 500 µg/ml, propineb 72WP and cymoxanil 8%+ mancozeb 64% WP exhibited cent per cent inhibition of mycelial growth followed by mancozeb 75WP and copper-oxychloride 50WP with 89.07 and 78.70 per cent inhibition of mycelial growth, respectively. All the fungicides completely inhibited the mycelial growth at 750 µg/ml except famoxadone 16.6%+ cymoxanil 22.1%SC and azoxystrobin 23%SC which showed only 53.88 and 32.96 per cent mycelial inhibition at 750 µg/ml, respectively. Hence, *in vitro* evaluation of fungicide revealed that all the fungicides except famoxadone 16.6%+ cymoxanil 22.1%SC and azoxystrobin 23%SC were effective against *P. nicotianae* var. *parasitica.* Famoxadone 16.6%+ cymoxanil 22.1%SC and azoxystrobin 23% SC gave 75.55 and 54.07 per cent mycelial inhibition at 1000 µg/ml and 77.40 and 57.59 per cent mycelial inhibition at 1500 µg/ml, respectively. At 2000 µg/ml, azoxystrobin 23% SC gave complete mycelial inhibition however,. famoxadone 16.6%+ cymoxanil 22.1% SC does not give complete mycelial inhibition even at 2000 µg/ml..

Efficacy of fungicides under field conditions

The fungicides tested *in vitro* were also evaluated as foliar sprays individually under field conditions during 2017 and 2018. The mean data of two years on per cent disease control and yield increase revealed that iprovalicarb 5.5%+ propineb 61.25% WP (Melody Duo 66.75 WP) gave maximum (54.72%) disease control with 81.51 per cent increase in yield followed by metalaxyl-M 4%+ mancozeb 64%WP (Ridomil Gold) which gave50.63 per cent disease control with 78.34 per cent increase in yield as compared to control. Copper-oxychloride 50WP (Blitox-50) was also found effective with 49.32 per cent disease control and gave 76.84 per cent increase in yield over check. Famoxadone 16.6%+ cymoxanil 22.1%SC (Equation pro) and azoxystrobin 23% SC (Mirador) resulted in 37.92 and 36.26 per cent control of buckeye rot with 46.76 and 46.46 per cent increase in yield over check. Famoxadone 16.6%+ cymoxanil 22.1%SC and azoxystrobin 23% SC were found to be least effective in controlling the disease as well increasing the yield over the control (Table 4). Hence, three sprays of iprovalicarb 5.5%+ propineb 61.25% WP (@0.25%) or metalaxyl-M 4%+ mancozeb 64%WP (@0.25%) or copper-oxychloride 50WP (@0.30%) were found most effective to manage the disease.

The efficacy of fungicides evaluated against *P. nicotianae* var. *parasitica* under *in vitro* and field conditions was also observed by many workers. Bhardwaj (1983) [2] found Blitox-50, Dithane Z-78, Antracol and Ziram fungicidal against *P. nicotianae* var. *parasitica* under *in vitro*. Kaur *et al*. (2011) screened Ridomil MZ 72 WP, Ridomil Gold 68 WP, Aliette 80 WP, Curzate M 8, Blitox-50 WP, Bordeaux mixture and Kocide 3000 against *P. nicotianae* var. *parasitica* at a concentration of 25, 50, 75 and 100 ppm. Among the fungicides screened, Ridomil Gold 68 WP, Ridomil MZ 72 WP and Curzate MZ were found significantly effective in inhibiting the growth of the pathogen. Wang *et al*. (2013) [27] found that mandipropamid strongly inhibited *P. parasitica* and provided the same efficacy as that of metalaxyl and superior than that of azoxystrobin.

Verma *et al*. (1994) [26] tested Dithane M-45 and Ridomil MZ-72 against *P. nicotianae* var. *parasitica* and *P. infestans* on different tomato cultivars found that cultivar Roma gave highest yield of quality fruits sprayed with Ridomil MZ-72 and best seed yield with Dithane M-45. However, many workers found copper oxychloride more efficient than other fungicides in combating the disease (Sohi and Sokhi, 1972; Sokhi and Sohi, 1974; Bhardwaj 1991) [24, 3]. Shyam and Gupta (1996) recommended combination of metalaxyl +mancozeb in checking the buckeye fruit rot of tomato. Gupta *et al*. (1998) screened six fungicides for the management of buckeye rot of tomato and maximum fruit yield was recorded in the treatment sprayed with mancozeb and copper-oxychloride followed by metalaxyl + mancozeb, propineb and captaf whereas, minimum fruit yield was recorded in the plot sprayed with chlorothalonil. Andreu and Caldiz (2006) reported that foliar spray of Melody Duo (iprovalicarb+ propineb) showed higher level of protection than propyl carbamate against *P. infestans*. Jagtap *et al*. (2013) [14] reported that Melody duo decreased the disease incidence and severity very effectively in late blight of potato.

Table 3: *In-vitro* evaluation of fungicides against *Phytophthora nicotianae* var. *parasitica*

Fungicides	Mycelial growth(mm)* at different concentrations (µg/ml)								Mycelial inhibition (%) at different concentrations (µg/ml)							
	50	100	250	500	750	1000	1500	2000	50	100	250	500	750	1000	1500	2000
Copper-oxychloride 50WP	43.00	37.00 (6.16)	24.00 (4.99)	19.17 (4.49)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	52.22	58.89	73.33	78.70	100.00	100.00	100.00	100.00
Mancozeb 75WP	26.83	22.16 (4.20)	19.16 (4.48)	9.83 (3.28)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	70.18	75.37	78.70	89.07	100.00	100.00	100.00	100.00
Propineb 72WP	26.96	23.50 (4.94)	13.50 (3.80)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	70.03	73.88	85.00	100.00	100.00	100.00	100.00	100.00
Azoxystrobin 23% SC	86.33	82.33 (9.12)	74.50 (8.68)	64.50 (8.09)	60.33 (7.83)	41.33 (6.50)	38.16 (6.25)	0.00 (1.00)	4.07	8.51	17.22	28.33	32.96	54.07	57.59	100.00
Cymoxanil 8%+ mancozeb 64% WP	41.00	36.00 (6.08)	32.00 (5.74)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0..00 (1.00)	0.00 (1.00)	54.44	60.00	64.44	100.00	100.00	100.00	100.00	100.00
Iprovalicarb 5.5%+ propineb 61.25% WP	12.50	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	86.11	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Metalaxyl-M 4%+ mancozeb 64%WP	34.50	16.67 (4.79)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	0.00 (1.00)	61.66	81.48	100.00	100.00	100.00	100.00	100.00	100.00
Famoxadone 16.6%+ cymoxanil 22.1%SC	67.83	56.66 (7.59)	48.16 (7.01)	42.33 (6.58)	41.50 (6.51)	22.00 (4.79)	20.33 (4.61)	18.50 (4.41)	24.62	37.03	46.48	52.96	53.88	75.55	77.40	79.44
Control	90.00	90.00 (9.53)	90.00 (9.53)	90.00 (9.53)	90.00 (9.53)	90.00 (9.53)	90.00 (9.53)	90.00 (9.53)	-	-	-	-	-	-	-	-
CD(p=0.05)	(0.94)	(0.12)	(0.13)	(0.12)	(0.04)	(0.03)	(0.03)	(0.03)								

Figures within parenthesis are square root transformed values

Table 4: Efficacy of fungicides against buckeye rot of tomato caused by *Phytophthora nicotianae* var. *parasitica* under field conditions

Treatment	Dose (per cent)	Buckeye rot incidence* (%)			Control (%)			Yield (q/ha)			Percent yield increase		
		2017	2018	Mean	2017	2018	Mean	2017	2018	Mean	2017	2018	Mean
Copper-oxychloride 50WP	0.30	28.39 (32.18)	25.75 (30.47)	27.07	51.75	46.35	49.32	181.33	185.33	183.33	78.95	74.84	76.84
Mancozeb 75WP	0.30	32.13 (34.51)	28.12 (32.00)	30.13	45.40	41.42	43.61	166.33	175.00	170.67	64.15	65.09	64.62
Propineb 72WP	0.25	31.26 (33.85)	29.56 (32.91)	30.41	46.88	38.42	43.07	174.00	162.67	168.33	71.72	53.46	62.37
Azoxystrobin 23% SC	0.10	41.10	27.00	34.05	30.16	43.75	36.26	146.33	157.33	151.83	44.41	48.43	46.46

		(39.85)	(31.29)										
Cymoxanil 8%+ mancozeb 64% WP	0.25	33.97 (35.63)	29.00 (32.56)	31.48	42.28	39.58	41.06	159.00	167.00	163.00	56.91	57.55	57.23
Iprovalicarb 5.5%+ propineb 61.25% WP	0.25	26.37 (30.86)	22.00 (27.95)	24.19	55.19	54.17	54.72	184.00	192.33	188.17	81.58	81.45	81.51
Metalaxyl-M 4%+ mancozeb 64%WP	0.25	29.53 (32.90)	23.22 (28.79)	26.38	49.83	51.62	50.63	179.10	190.67	184.88	76.75	79.87	78.34
Famoxadone 16.6%+ cymoxanil 22.1%SC	0.05	37.99 (38.02)	28.33 (32.14)	33.16	35.45	40.97	37.92	153.67	150.67	152.67	51.65	42.14	46.78
Control	-	58.85 (50.07)	48.00 (43.83)	53.42	-	-	-	101.33	106.00	103.67	-	-	-
CD(p=0.05)		3.17	1.18					2.15	2.52				

*Figures within parenthesis are angular transformed value

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