PHYSICO CHEMICAL CHARACTERIZATION OF VERMICOMPOST AND ITS IMPACTS ON CHILLI PLANTS (*CAPSICUM ANNUUM L.*)

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ABSTRACT: *Earthworms are very important components for the maintenance of soil fertility and nutrient cycling. They feed on all types of organic matter. Employing earthworms, vermicompost can be produced from various organic wastes generating from different sources such as agricultural, industrial and municipal. Nowadays, these wastes are the main cause of environmental pollution in developing countries. Adapting 4R strategies namely Reuse, Reduce, Recycle, and Recover on the above mentioned wastes through the activity of earthworms could be converted into value added marketable biofertilizer and vermicompost. Cow dung and organic waste materials were collected from different places and prepared vermicompost and vermicompost rubbish in different concentrationsandthey appliedfoe selected vegetable cropsand finding are vermicompost rubbish also contain more nutrient value next to vermicompost, vermicompost efficiently working in vegetable crop, among the different concentrations 50:50 concentration of cow dung and organic waste shows good results, from this research conclussion shows organic waste, cowdund and vermicompost also working well in crop plants, vermicompost rubbish also can utilize for the crop production.*

Key Words: *vermicompost, vermicompost rubbish, earthworm, organic waste, chilli plant*

INTRODUCTION

In today's era, heavy doses of chemical fertilizers and pesticides are being used by the farmers to get a better yield of various field crops within short period. These chemical fertilizers and pesticides decreased soil fertility and caused health problems to the consumers. Due to adverse effects of chemical fertilizers, interest has been stimulated for the use of organic manures (Follet *et al.,* 1981). Earthworm gut consist of variety of enzymes such as proteases, amylase, invertase, protease, lipase, cellulose, chitinase (Ranganathan and Vinotha, 1998), xylanase, cellubiase, endonucleases, acid phosphatase, alkaline phosphatase, nitrate reductase (Karthikeyan *et al.,* 2004), catalase, peroxidase, polyphenol oxidase, Exo-β 1,4 glucanase, Endo-β 1,4 glucanase, superoxide dismutase and glutathione reductase (Prabha, 2006), orthophosphate and dehydrogenase (Norman *et al.,* 2003). Vermicomposting technology involves the bio-conversion of organic waste into vermicasts and vermiwash utilizing earthworms. These earthworms feed on the waste and their gut act as the bioreactor where the vermicasts are produced. These vermicasts are also termed vermicompost and are rich in nitrogen, phosphorous, potassium and micronutrients. In addition, during the vermicomposting process, a leachate is produced which is called vermiwash. Vermiwash is also rich in the fertilizer macro and micronutrients. These vermi-products can be utilized as bio-fertilizers and has been applied in various crops.

Maynard (1993), who reported that tomato yield in field soils amended with compost were significantly greater than those in the untreated plots. The use of compost in commercial production of *Chrysanthemum morifolium* was advocated by Martinez and Gomez (1995). Edwards (1995) reported that in a Rothamsted study with 25 types of vegetables, fruits or ornamentals, earthworm cast performed better than compost or commercial potting mixture amendments. A study carried out by Kale and Bono (1996) in summer paddy (IR-20) found that the vegetative growths like shoot weight, root weight, root and shoot length were influenced by the application of worm cast in a better way than chemical fertilizer.

Nagarajan (1997) obtained higher net income by application of vermicompost in rice. Sainz *et al.,* (1988) reported that addition of vemicompost to soil resulted in increased mineral contents in the substrate and higher concentrations P, Ca, Mg, Cu, Mn and Zn in shoot tissue of red clover and Zn in shoot tissues of red clover and cucumber. Vermicompost has been shown to promote growth of a wide range of cereals, vegetables, ornamentals plants etc (Kale, 1998). Ghosh *et al.,* (1999) reported that integration of vermicompost with inorganic fertilizer tended to increase the yield of crops *viz*. potato, rape seed, mulberry and marigold over that with traditional compost prepared from the same substrate.

Vermicompost plays a major role in improving growth and yield of different field crops, vegetables and flower and fruit crops. Darwin (1881) put forward,' earthworms prepare the ground in an excellent manner for the growth of fibrous – rooted plants and for seedlings of all kinds. When earthworms are available in soils they always promote plant growth (Edwards and Lofty, 1980). Nijhawan and Kanwar (1952) also observed that the application of casting even in small dose increased the gain yield by 18 percent in pot culture but when their dose was 20% of the soil, the yield was nearly doubled.In view of the above facts an attempt has been made to study the growth and yielding pattern of selected vegetable crop *i.e.,* chilli by using Vermicompost and vermicompost rubbish with the following objectives, to prepare and study the different concentrations of vermicompost and vermicompost rubbish for the cultivation of selected vegetable crop, to determine the nutrient composition of vermicompost, vermicompost rubbish and to study the growth and yielding patterns of chilli by application of vermicompost and vermicompost rubbish.

MATERIALS AND METHODS

Fresh cow dung and organic waste collected from Vadugapatti village (10° 45' to 30° 16' N and 78° 70' to 27° 38' E), Musiri Taluk, Tiruchirappalli District, India. they spread over clean terrain and allowed for 10 to 15 days, they thoroughly mixed with one another and mixture was prepared in three different concentrations *i.e.,* 40:60 (40% cow dung and 60% organic wastes); 50:50 (50% cow dung and 50% organic wastes) and 60:40 (60% cow dung and 40% organic wastes) and control (cow dung only) also maintained and kept in clean shadow place, water sprinkled every day to keep maintain the moisture. After decomposition, they filled in separate cement tanks size (Size 3 m x 6 m x 3 m) in triplicates and 50 number of adult *Eudrilus eugeniae* was inoculated. After 4 weeks, endproduct collected and sieved by 3 mm mesh. The separated vermicompost and vermicompost rubbish (sieved out matter) were collected and stored in cool and dry place for further experiments. pH, Electrical Conductivity (EC), Moisture, Organic Carbon, determined as suggested by Tandon (2005), Total Nitrogen determined by Micro Kjeldahl method, Total Phosphorous determined by Spectrophotometric method, Total Sulphur estimated as suggested by Tandon (2005). Determination of Total Sodium and Total Potassium by Flame Photometric Method, Estimation of Total Calcium and Magnesium by Versenate method.

Experiment was conducted at wet lab in Arignar Anna Government Arts College, Musiri, Tamil Nadu, India. Experimental chilli field plot was design 5m x 5m area, the unwanted plants were removed, soil nutrients were analysed before and after cultivation of chilli crop. Control plot was maintain for chilli crop. In experimental plot the selected vegetable crop namely, Chilli was planted in each 20 numbers both in control and each experimental plots, experimental plot I (40:60 vermicompost), experimental plots II (50:50 vermicompost), experimental plot III (60:40 vermicompost) and experimental plot IV (40:60 vermicompost rubbish), Experimental Plot V (50:50 vermicompost rubbish), experimental plot VI (60:40 vermicompost rubbish), experimental plot VII (vermicompost control). Experimental Plot VIII (vermicompost rubbish control).

RESULTS AND DISCUSSION

There is an increasing interest in the potential use of vermicompost as plant growth media and soil amendments. Vermicompost could be utilized effectively for sustainable plant production at low input-basis green farming. The effects of such vermicomposts on the rates of growth of a variety of crops including, vegetables and ornamentals have been assessed in the greenhouse and some field crops. Vermicomposting offers a solution to tonnes of organic agro-wastes that are being burned by farmers and to recycle and reuse these refuse to promote our agricultural development in more efficient, economical and environmentally friendly manner.

In the present study, vermicompost and vermicompost rubbish prepared from cow dung and leaf litter at different concentrations *i,e.,* 40:60, 50: 50, 60:40 and control, were quantified. The result showed harvested vermicompost quantitatively higher than the vermicompost rubbish and they presented in table 1. Physico-chemical parameters of vermicompost and vermicompost rubbish nutrients was analyzed and presented in table 2. The pH was recorded with slightly acidic condition in the ratio of 40:60 and control. Higher electrical conductivity (0.52±0.02) and moisture content (25.93±0.49) were observed in the ratio of 50:50 than the control, the percentage of the total organic carbon, total nitrogen, total phosphorous, total potassium, total sodium, total calcium and total magnesium were higher in 50:50 ratio over the control. The sulphur content was significantly higher in control when compare to other ratios. Percentage of total calcium and total magnesium were observed maximum in the ratio of 50:50. In vermicompost rubbish pH was recorded with slightly acidic condition in the ratio of 40:60 and control. Higher electrical conductivity and moisture content were observed in the ratio of 50:50 than the control, the percentage of the total organic carbon, total nitrogen, total phosphorous, total potassium, total sodium, total calcium and total magnesium were higher in 50:50 ratio over the control. The sulphur content was significantly higher in control when compare to other ratios. Percentage of total calcium and total magnesium were observed maximum in the ratio of 50:50. In vermi wash p^H was recorded with slightly alkaline condition in the all concentrations. Higher electrical conductivity was observed in 60:40 concentrations, the percentage of the total organic carbon, total nitrogen, total phosphorous, total potassium, total sodium, total calcium and total magnesium were higher in 50:50 concentration. The sulphur content was significantly higher in 60: 40 concentrations. Percentage of total calcium and total magnesium were observed maximum in the ratio of 50:50.

Growth and yielding pattern of chilli plant by the application vermicompost in different intervels, in 0^{th} day number of leaves was significantly observed at 40:60 ratio (7±1.93). Whereas plant height, number of flowers, number of fruits and weight fruits were not significant, in 30^{th} day number of leaves was observed statically significant (*p>0.05* level) (27±5.35) in all experimental plot compared to control. Whereas plant height, number of flowers, number of fruits and weight fruits were not significant, in 60^{th} day number of leaves (59±8.42), plant height (52±3.52), number of flowers (33±5.97) and number fruits (22±2.82) were observed significantly. Whereas weight fruits were not significant compared to control, in 90^{th} day number of leaves (98±7.24), plant height (95±8.93), number of flowers (64±9.93) and number of fruits (59±8.95) and weight of the fruits (306±8.83) were observed significantly (Table-3).

Growth and yielding pattern of chilli plant by the application of vermicompost rubbish in the 0 day sapling maximum height was observed statically significant at 40:60 ratio (18±0.73), whereas number of leaves, number of flowers, number of fruits and weight fruits were not statistically significant. In 30^{th} day number of leaves was observed statistically significant at 40:60 ratio (25±4.85), whereas plant height, number of flowers, number of fruits and weight fruits were not statistically significant. In 60^{th} day number of leaves, plant height, number of flowers and number of fruits clearly revealed that maximum at 50:50, whereas weight fruits were not statistically significant. In the 90^{th} day data pertaining to the number of leaves, plant height, number of flowers, number of fruits and weight of the fruits clearly revealed that maximum at 50:50. One-way analysis of variance (ANOVA) followed by least significant difference (LSD) test showed statistical significance ($p<0.05$) compared to control (Table - 3).

The physicochemical properties of available nutrients in before and after cultivation of chilli plants during the application of vermicompost were recorded and they provided in Table: 3. Nutrients such as p^H, Electrical conductivity (dSm^{-1}), Moisture, Organic Carbon , Nitrogen ,Phosphorous, Potassium, Sodium ,Sulphur , Calcium, Magnesium and C:N ratio were increased in all three experimental plots (40:60,50:50 and 60:40) after application of vermin compost when compared with control plot. Among these three concentrations, nutrients level was observed appreciably high in 50:50 concentrations. The range of nutrients was pH (7.1±0.25), Electrical conductivity (0.12±0.00) , Moisture (83±5.33), Total Organic Carbon (11.45±1.48), Total Nitrogen (0.81±0.16), Total Phosphorous (0.41±0.00), Total Potassium(0.69±0.01), Total Sodium (0.57±0.06), Total Sulphur (2.36±0.35), Total Calcium (0.52±0.04), Total Magnesium(2.47±0.04) and C:N (11:1). Duting the vermicompost rubbish nutrients such as p^H, Electrical conductivity (dSm^{-1}), Moisture, Organic Carbon, Nitrogen, Phosphorous, Potassium, Sodium ,Sulphur, Calcium, Magnesium and C:N ratio were increased in all three experimental plots (40:60,50:50 and 60:40) after cultivation when compared with control plot. Among these three concentrations, the nutrients level was observed appreciably high in 50:50 concentrations. The range of nutrients was pH (7.3±0.53), Electrical conductivity (0.11±0.00), Moisture (76±4.92), Total Organic Carbon (9.64±0.65), Total Nitrogen (0.65±0.13), Total Phosphorous (0.41±0.01), Total Potassium (0.71±0.03), Total Sodium (1.34±0.03), Total Sulphur (1.84±0.18), Total Calcium (0.48±0.02), Total Magnesium (2.24±0.03) and C: N (9:1).

Azarmi *et al.,* (2008) have suggested that the addition of vermicompost (5-10 tones per hectare) increased the total yield of tomato fruits per plant, total yield of fruits (10 to 15 tones of vermicompost per hectare). They have also reported that the total yield of fruits per plant increased 1.7 times at rate of 15 tones of vermicompost per hectare compared to control. Azarmi *et al.,* (2008) have suggested that growth yield parameters such as leaf area, dry shoot weights and weights of fruits of tomato plant (*Lycopersicum esculentum*) increased significantly by applying vermicompost. Arancon and Edwards (2009) have proved that vermicompost can have dramatic effects on the germination, growth, flowering, fruiting and yields of crop independent of the availability of nutrients. They have also demonstrated dramatic effects of vermicomposts produced from pig and cattle manure and food and paper washes on a range of ornamental and vegetables in the green house.

Vermicomposting is a technology that involves the bioconversion of organic waste into bio-fertilizers by the use of the earthworms (Jadia and Fulekar, 2008 and Manyuchi *et al.,* 2013). This technology is increasingly becoming popular as a solid waste management strategy. During the vermicomposting process, earthworms feed on the organic waste and their gut act as a bioreactor such that vermicasts are expelled (Ansari and Sukhraj 2010; Nath *et al.,* 2009). These vermicasts are rich in the macro and micronutrients of a fertilizer (Palanichamy *et al,* 2011). Furthermore, vermiwash, a brownish leachate is produced during the vermicomposting process. Vermiwash is also rich in the macro and micronutrients of a fertilizer and can also be used as a foliar spray (Gopal *et al.,* 2010). Vermicompost treated soil showed increased plant growth, number of leaves, flowers and fruits compared to control soil. Significant yield was recorded on vermicompost soil (Sundararasu and Neelanarayanan, 2012).

Kale *et al.,* (1982) reported that application of vermicompost has significant effect on mycorrhizal colonization, root volume, root and shoot dry weight. Bugbee and Frink (1989) revealed that the shoot dry weights of marigold plant improved significantly with increasing concentration of vermicompost. Reddy (1988) proved increased growth of *Vinca rosea* and *Oryza sativa* after addition of casts from earthworm, *Pheretima alezandri.* Most plants germinated and grew better in worm – worked waste than in commercial plant growth media (Edwards and Burrows, 1988). Kale *et al.,* (1992) revealed that in low rice, applying vermicompost improved uptake of nutrient, increased level of N, P and microbial load and higher level of symbiotic association resulted in increased effect on growth and yield. Application of crops had immediate benefits as the nutrients can be directly absorbed. When applied to direct sown rice, the seedlings turned dark green immediately after emergence (Gunathilagaraj, 1994). Ismail (1995) revealed significantly higher yield in bhendi, Chillies, watermelon and paddy by vermicompost application than Farm yard manure. He has also reported that the vermicompost has a favorable influence on all yield parameters of sugarcane i.e. number of canes per hill, internodes distance, stem length, shoot length, cane yield and quality.

Gh.Peyvast *et al.,* (2008) revealed that the addition of vermicompost increased the plant height, leaf fresh weight, root fresh weight, leaf dry weight and root dry weight of the plant, Parsley (*Petroselimum crispum* Mill) in all vermicompost mixtures (10:100 vermicompost: soil treatment) than in control. Vermicompost has been found to have a favorable influence on all yield parameters of crops like wheat, paddy and sugarcane (Ansari, 2007). Chamani *et al.,* (2008) have reported that shoot fresh and dry weights, leaf number and flower number of Dream Neon Rose (*Petunia hybrida*) have been observed to increase when it was exposed to 20 and 40% vermicompost. They have also expressed that N, P, K, Ca, Mg, Fe, Zn and Cu concentrations in shoot tissues of Dream Neon Rose increased significantly with increasing of vermicompost volumes in the base media compared to the control. Ansari (2008) has proved that the yield of Spinach (*Spinacia oleracea*), Onion (*Allium cepa*) and Potato (*Solanum tuberosum*) were significantly higher in plots treated with vermiwash (1:5v/v in water), vermiwash (1:10 v/v in water) and vermicompost and vermiwash (1:5 v/v in water) respectively.

Vermicompost, a widely used premium organic fertilizer, is the by-product of symbiotic interactions between earthworms and microorganisms living within them. It has been postulated that phytohormones are plausible "magic compounds" in Vermicompost that are responsible for making them such good fertilizers (Zhang *et al.,* 2015). Hangarge *et al.,* (2002) have reported that the application of vermicompost enhanced the yield of chilli and leaf yield of spinach. Gajalakshmi and Abbasi (2004) expressed that plant height, number of leaves, root length, total biomass, number of flowers and fruits, length of inflorescences and quicker onset of flowering of the plants such as lady's finger (*Abelmoschus esculentus*),brinjal (*Solanum melongena*), cluster bean (*Cyamopis tetragonoloba*), chilli (*Capsicum annum*) and tomato (*Lycopersicum esculentum*) have been found to have significant increase than the control plot when they were exposed to various percentage of water hyacinth vermicompost.

Vermicomposting is a technology that involves the bioconversion of organic waste into bio-fertilizers by the use of the earthworms (Abbasi, *et al.,* 2009). This technology is increasingly becoming popular as a solid waste management strategy. During the vermicomposting process, earthworms feed on the organic waste and their gut act as a bioreactor such that vermicasts are expelled (Ansari and Sukhraj 2010). These vermicasts are rich in the macro and micronutrients of a fertilizer (Manyuchi *et al.,* 2013). Furthermore, vermiwash, a brownish leachate is produced during the vermicomposting process. Vermiwash is also rich in the macro and micronutrients of a fertilizer and can also be used as a foliar spray (Quaik *et al.,* 2012). Vermicompost treated soil showed increased plant growth, number of leaves, flowers and fruits compared to control soil. Significant yield was recorded on vermicompost soil (Sundararasu and Neelanarayanan, 2012). The macronutrients include nitrogen, phosphorous and potassium whereas the micronutrients include boron, copper, iron, manganese, molybdenum and zinc (Manyuchi *et al.,* 2013). Sundararasu and

Jeyasankar (2014) reported that vermiwash spray enhanced growth parameters and yield parameters on brinjal. The combination of vermicompost and vermiwash showed maximum positive effects on the growth and flowering of Zinnia sp. compared to either vermicompost alone or vermiwash alone (Amita, 2014). Vermicompost, a widely used premium organic fertilizer, is the by-product of symbiotic interactions between earthworms and microorganisms living within them. It has been postulated that phytohormones are plausible “magic compounds” in Vermicompost that are responsible for making them such good fertilizers (Zhang *et al.,* 2015). Even though much work has been done on vermicompost, very few reports are available related to vermicompost rubbish and vermiwash, its impact on the growth and yield of vegetable crops.

In the present study an attempt has been made to study the Effect of vermicompost and vermicompost rubbish on growth and yield of selected chilli vegetable crop. Significant effect has been observed in all ratios of vermi end product than control, even though 50:50 ratio shows more significant than other ratios of 40:60 and 60:40. Growth and yielding pattern shows most significant in 50: 50 ratio vermi end product applied fields. After the application of vemi end products, in all experimental plots, physic-chemical nutrients have been improved.

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Table 1: Harvesting and quantification of vermicompost and vermicompost rubbish

Name of the end product	Ratio	Quantity of end product from 1000 kg
Vermicompost	Control	864 kg
	40:60	876 kg
	50: 50	838 kg
	60:40	841 kg
Vermicompost rubbish	Control	118 kg
	40:60	108 kg
	50: 50	111 kg
	60:40	102 kg

Table 2: Physico-Chemical nutrient analyses of vermicompost

Name of the parameters	Different ratio of vermicompost				Different concentration of vermicompost rubbish			
	Control	40:60	50:50	60:40	Control	40:60	50:50	60:40
p^H	6.8±0.16	6.66±0.24	7.06±0.32	7.13±0.47	6.42±0.14	6.81±0.16	7.02±0.17	7.31±0.18
Electrical conductivity (dSm^{-1})	0.49±0.01	0.52±0.02	0.52±0.02	0.51±0.01	0.21±0.01	0.21±0.01	0.23±0.02	0.24±0.02
Moisture (%)	21.7±0.41	23.5±0.52	25.93±0.49	24.86±0.53	23.5±0.35	24.6±0.46	26.85±0.46	25.74±0.47
Total Organic carbon (%)	12.33±0.28	13.34±0.35	13.38±0.41	13.02±0.32	12.43±0.18	13.83±0.7	13.89±0.27	13.16±0.2
Total Nitrogen (%)	1.630±0.07	1.72±0.03	1.84±0.02	1.81±0.02	1.21±0.07	1.65±0.05	1.73±0.08	1.36±0.06
Total Phosphorous (%)	1.21±0.06	1.35±0.08	1.75±0.02	1.48±0.03	1.21±0.03	1.06±0.04	1.43±0.05	1.41±0.02
Total Potassium (%)	0.97±0.00	1.23±0.03	1.64±0.34	1.45±0.04	0.93±0.01	1.27±0.06	1.40±0.06	1.35±0.02
Total Sodium (%)	1.37±0.08	1.54±0.04	1.78±0.02	1.42±0.07	1.39±0.05	1.45±0.06	1.64±0.04	1.38±0.07
Total sulphur (%)	2.61±0.29	2.18±0.25	2.34±0.28	2.42±0.31	2.59±0.14	2.13±0.15	2.26±0.09	2.37±0.08
Total Calcium (%)	1.34±0.04	1.46±0.03	1.79±0.07	1.72±0.02	1.21±0.07	1.35±0.06	1.74±0.04	1.69±0.02
Total Magnesium (%)	1.56±0.03	1.46±0.04	1.75±0.02	1.75±0.03	1.34±0.05	1.48±0.03	1.82±0.07	1.41±0.01
C:N ratio	12:1	13:1	13:1	13:1	1:12	13:1	13:1	13:1

Values represent mean ± S.D of three replications

Table 3: Growth and yielding pattern of chilli plant by application of vermicompost and vermicompost rubbish

Vermicompost						Vermicompost rubbish	0th Day				
	No. of leaves	Plant height (cm)	Number of flowers	Number of fruits	Weight of the fruits (g)		No. of leaves	Plant height (cm)	Number of flowers	Number of fruits	Weight of the fruits (g)
Control	6±2.04^{a}	16±2.68^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00 a	Control	7±0.14^{ab}	14±0.93^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
40:60	7±1.93^{ab}	15±2.02^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	40:60	6±0.15^{a}	16±0.82^{b}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
50:50	5±1.72^{a}	15±3.81^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	50:50	5±0.17^{a}	18±0.73^{c}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
60:40	6±1.08^{a}	17±1.04^{b}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	60:40	6±0.15^{a}	17±0.82^{b}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
30th Day						**30th Day**					
Control	19±4.75^{a}	25±5.35^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	Control	18±3.62^{a}	24±4.25^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
40:60	24±6.25^{b}	25±4.64^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	40:60	22±5.39^{b}	24±2.83^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
50:50	27±5.35^{c}	27±6.72^{b}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	50:50	25±4.85^{bc}	25±2.64^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
60:40	24±7.83^{b}	24±2.43^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	60:40	24±7.83^{b}	25±1.54$_{a}$	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
60th Day						**60th Day**					
Control	46±7.31^{a}	43±2.05^{a}	21±5.82^{a}	13±1.84^{a}	0±0.00^{a}	Control	45±4.73=	42±2.92^{a}	18±5.80^{a}	12±3.64a	0±0.00^{a}
40:60	51±10.63^{b}	46±3.91^{b}	25±6.88^{b}	15±2.75^{b}	0±0.00^{a}	40:60	48±7.34^{b}	44±5.83^{a}	25±7.72^{b}	13±2.43a	0±0.00^{a}
50:50	59±8.42^{d}	52±3.52^{d}	33±5.97^{c}	22±2.82^{c}	0±0.00^{a}	50:50	54±5.20^{c}	51±5.21^{c}	30±2.43^{c}	20±2.94c	0±0.00^{a}
60:40	57±8.94^{c}	50±2.63^{c}	26±7.92^{b}	21±4.91^{c}	0±0.00^{a}	60:40	53±3.74^{c}	46±6.27^{b}	23±2.54^{b}	17±3.82b	0±0.00^{a}
90th Day						**90th Day**					
Control	80±6.93^{a}	74±6.34^{a}	55±11.04^{a}	48±15.74^{a}	257±10.92^{a}	Control	72±4.74^{a}	69±8.92^{a}	48±8.85^{a}	47±12.93^{a}	231±4.25^{a}
40:60	96±9.06^{c}	82±8.27^{b}	62±5.29^{c}	55±9.22^{ab}	283±7.94^{b}	40:60	89±8.93^{b}	80±7.70^{b}	56±7.36^{b}	49±10.56^{a}	264±3.64^{b}
50:50	98±7.24^{d}	95±8.93^{d}	64±9.93^{c}	59±8.95^{c}	306±8.83^{c}	50:50	91±6.72^{bc}	89±8.26^{c}	59±7.33^{c}	53±10.11^{b}	314±3.53^{c}
60:40	92±6.43^{b}	89±6.46^{c}	59±6.28^{b}	52±9.24^{a}	278±6.96^{b}	60:40	88±8.28^{b}	82±9.94^{b}	53±7.81^{b}	47±8.34^{a}	256±2.35^{b}