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RESEARCH PAPER

Effect of application of excreta of livestock animals and methods of their decomposition on the growth parameters of tomato (*Lycopersicum esculentum* L.)

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Abstract : Field trial was conducted during 2013 - 2014 to assess the effects of application of different types of livestock animals excreta and methods of their decomposition on tomato (*Lycopersicum esculentum* L.) crop growth parameters like plant height and number of compound leaves at 30 days after transplanting and at harvest stage; number of fruits per plant; fruits weight and volume were recorded. The results of this study showed that the plant height and number of compound leaves at 30 days after transplanting and at harvest stageand fruit weight and fruit volume were maximum in case of poultry followed by goat and minimum in case of duck excreta. Methods of decomposition also exhibited a significant difference in growth parameters of tomato. The highest growth and yield were recorded in T_3 (Animal excreta + Crop residues + Earthworm) followed by T_2 (Animal excreta + Earthworm) and least was obtained from T_1 (Animal excreta).

Key Words : Tomato, Animal excreta, Vermicompost, Plant height, Fruit number, Leaves, Fruit weight

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INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is a species of Solanaceae family native to southern North America and northern Southern America are native to Ecuador, Peru and the Galapagon Island however, record advocated that *Lycopersicum* species was domestication first was in Mexico (Taylor, 1986). Botanically tomato is a fruit, the ovary, together with its seeds, of a flowering plant (Wang *et al*., 2009). Tomato plays an important role in human diet as it is a good source of important vitamins and minerals. Tomato fruits are used as uncooked fruit salad and also cooked with spicy vegetables, sandwiched with bread and it is processed into juice, ketchup, soup, puree, peeled potatoes etc. (Olaniyi and Ajibola, 2008). In Fiji, planting time for tomato crop is usually in cooler months (May to October) but offseason tomato is planted when demand is more than supply. Organic agricultural products are high in demand and farmers are getting good price for their organic produce. The organic manure application makes

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the farming sustainable and profitable.The use of animal excreta in the form of well decomposed compost as soil amendment has been recognized as an effective means for improving soil aggregation, structure and fertility (Workneh and Van Bruggen, 1994) increasing microbial diversity and populations improving the moisture-holding capacity of soils, increasing the soil cation exchange capacity (CEC) and increasing crop yields (Marinari *et al*., 2000). It is scientifically evident that incorporation of animal excreta of certain livestock animals into soil or planting mixes can provide effective biological control for disease caused by soil borne pathogens (Workneh and Bruggen, 1994) and vermicomposts can influence the growth and productivity of plants significantly (Edwards, 1998).

In the process of decomposition of animal excreta using earthworms the animal manures and farm waste can be converted in vermicompost. The ability of some species of earthworm to consume and breakdown a wide range of organic residues such as sewage and sludge, animal wastes, crop residues and industrial refuse is well known (Dominguez *et al*., 1997; Edwards *et al*., 1985 and Kaushik and Garg, 2003). Annul application of adequate amounts of some organic residues (vermicompost) led to significant increase in soil enzyme activities such as urease, phosphomonoesterase, phosphodiesterase and arylsulphatase (Albiach *et al*., 2000). To meet the timely requirement of sufficient amount of organic manure of different livestock excreta'swere decomposed along with plant residue and earthworm and decomposed organic manure were evaluated to understand their impact on the plant parameters and fruit yield at the Instructional farm complex of the College of Agriculture, Fisheries and Forestry, Koronivia, Fiji.

MATERIAL AND METHODS

The experiment was conducted during winter season of 2013-14 at green house (cloth shade)of the College of Agriculture, Fisheries and Forestry (CAFF), Fiji National University, Fiji. The experimental area has tropical climate characterized by frequent rainfall during November to April and scanty rainfall during rest of the year. The annual precipitation was 3000 mm (Fiji, 2016). The average maximum temperature was 26°C and average minimum temperature was 21°C. The average mean temperature was 23°C. The relative humidity varied from 71.5 to 81.3 per cent. The day length was 10.5 – 11.0 hours only and there was occasional rainfall from the beginning of the experiment to harvesting stage.

The experiment comprised of 6 types of animals excreta *viz.*, duck, goat, poultry, pig, sheep and cow and 3 types of decomposition methods of animal excreta *viz*., animal excreta (T_1) under natural decomposition, animal excreta decomposed in presence of earthworm (T_2) and animal excreta and crop residues decomposed in presence of earthworm (T_3). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications of each treatment combinations.

The filled plastic pots were arranged in RCBD and replications for all treatments were placed as per the layout of the design.The total number of treatment combinations under study were 18 (6 types of animal excreta and 3 methods of decomposition) and 5 potted plants for each treatment combination were maintained in each row replicated thrice and such a total of 270 pots were used for the experiment.Golden Sunrise variety of tomato was used in this study. The tomato seedlings were raised in nursery and transplanted after 21 days to prepared pots. Only healthy and uniform sized 21 days old seedlings were taken from the seed bed and were transplanted in the experimental pots maintaining a spacing of 1m and 0.5m between the rows and plants, separately. Gap filling, weeding, irrigation and pest management were done as per the requirement.

Fruits were harvested at 7 days intervals starting at first ripening of fruit. The maturity of the crop was determined on the basis of size and colour of fruits. Three (3) plants from each replication were selected randomly and were tagged for the data collection. The collected data were analyzed statistically using ANOVA technique. The test of significance for all the parameters was done. The Duncan's Multiple Range Test (DMRT) with least significant difference value was determined with appropriate levels of significance and the means were tabulated. The mean comparison was carried out by DMRT technique (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

The plant height recorded at 30 Days after transplanting (DAT) and at harvest was significantly higher in case of poultry followed by goat (Table 1). The plant height of tomato was maximum at 30 DAT (64.1 cm) and at harvest (90.78 cm) applied with poultry followed by goat at 30 DAT (61.0 cm) and at harvest (88.9 cm) and was minimum at 30 DAT (34.6 cm) and at harvest (71.3 cm) in case of duck. Height of tomato plants at 30 DAT and at harvest increased significantly with treatments (Table 1). The maximum plant height was recorded (58.9 cm) at 30 DAT and at harvest (87.9 cm) was found with animal excreta + crop residues + earthworm (T_3) which was followed by animal excreta + crop residues (T_2). The minimum plant height at 30 DAT (47.8 cm) and at harvest (71.2 cm) was observed in the treatment animal excreta under natural

Table 1: Effect of types of animal excreta and decomposition methods on plant height (cm) of tomato

Treatments	Plant height (cm)	
	At 30 DAT	At harvest
Animal excreta		
Duck	34.6	71.3
Goat	61.0	88.9
Poultry	64.1	90.8
Pig	56.6	79.1
Sheep	53.7	75.8
Cow	53.8	74.0
S.E.±	0.59	0.76
C.D. (P=0.05)	1.20	1.55
Decomposition method		
T_1: Animal excreta	47.8	71.2
T_2: Animal excreta + Earthworm	55.2	80.8
T_3: Animal excreta + Crop residues + Earthworm	58.9	87.9
S.E.±	0.42	0.54
C.D. (P=0.05)	0.85	1.10

T_1= (Animal excreta under natural decomposition), T_2= (Animal excreta + earthworm) and T_3= (Animal excreta + crop residues + earthworm)

Table 2: Effect of types of animal excreta and decomposition methods on number of compound leaves of tomato

Treatments	Number of compound leaves	
	At 30 DAT	At harvest
Animal excreta		
Duck	10.6	13.3
Goat	14.9	18.3
Poultry	16.7	20.5
Pig	13.9	16.9
Sheep	13.6	16.4
Cow	13.2	13.9
S.E.±	0.13	0.39
C.D. (P=0.05)	0.26	0.78
Decomposition method		
T_1: Animal excreta	10.7	14.5
T_2: Animal excreta + Earthworm	14.5	17.1
T_3: Animal excreta + Crop residues + Earthworm	16.3	18.1
S.E.±	0.09	0.27
C.D. (P=0.05)	0.19	0.55

T_1= (Animal excreta under natural decomposition), T_2= (Animal excreta + earthworm and T_3= (Animal excreta + crop residues + earthworm)

decomposition (T_1).

Observed data indicated that the number of compound leaves at 30 DAT and at harvest was significantly higher in case of poultry followed by goat (Table 2). The highest number of compound leaves at 30 DAT (16.7) and at harvest (20.5) was recorded with poultry followed by goat at 30 DAT (14.9) and at harvest (18.3) and the lowest at 30 DAT (10.6) and at harvest (13.3) was found in case of A_1. Higher values of number of compound leaves of tomato plants at 30 DAT and at harvest were also observed with treatments. The maximum number of compound leaves recorded (16.3) at 30 DAT and at harvest (18.1) were found with animal excreta + crop residues + earthworm (T_3) which was followed animal excreta + crop residues (T_2). The minimum number of compound leaves at 30 DAT (10.7) and at harvest (14.5) was identified for animal excreta under natural decomposition (T_1).

Data in Table 3 indicated that the average numbers of fruits (ANF), fruit weight (AFW) and average fruit volume (AFV) were maximumin case of poultry followed by goat and minimum was in duck. The highest number of average fruits (6.1), average fruit weight (140.4 g) and average fruit volume (60.7 mm) was recorded with poultry excreta and was significantly higher than the other treatments whereas the lowest average number of fruits (3.7), average fruit weight (89.3 g) and fruit volume (49.0 mm) was observed in case of duck. Average number of fruits, average fruit weight and average fruit volume was also increased significantly with methods of increasing order of treatments of decomposition of animal excreta (Table 3). The maximum number of average number of fruits (5.9), fruit weight (145.5 g) and fruit volume (58.7 mm) were recorded with animal excreta + crop residues + earthworm (T_3) which was followed animal excreta + crop residues (T_2). The lowest average number of fruits (3.9), fruit weight (82.8 g) and fruit volume (48.4 mm) were observed with animal excreta under natural decomposition (T_1).

The result of the present study showed that growth parameters of tomato crop performed very well with poultry excreta followed by goat, this might be due to the high nutritive quality of feed given to poultry birds that produced animal excreta of high nutritive under different type of decompositions methods. The goat dropping performed second to the poultry and could be the reason as the goat droppings contain in natural coating material could help in release of available plant nutrients. Treatment T_3 (animal excreta + crop residues + earthworm) resulted maximum performance and could be the reason that availability of sufficient moisture or succulence in decomposed material provided important plant nutrients in available form to tomato at all time. Similar results were also reported by Ojeniyi *et al.* (2007); Dantata *et al.* (2011) and Olatunji and Oboh (2012).

Table 3: Effect of types of animal excreta and decomposition methods on average number of fruits, fruit weight (g) and fruit volume (mm) of tomato

Treatments	Average number of fruits	Average fruit weight (g)	Average fruit volume (mm^3)
Animal excreta			
Duck	3.7	89.3	49.3
Goat	5.5	127.0	58.3
Poultry	6.1	140.4	60.7
Pig	5.1	116.7	54.0
Sheep	4.5	109.5	52.3
Cow	4.5	107.5	51.5
S.E.±	0.20	8.44	1.80
C.D. (P=0.05)	0.40	17.16	3.66
Decomposition method			
T_1: Animal excreta	3.9	82.8	48.4
T_2: Animal excreta + Earthworm	4.9	117.0	55.8
T_3: Animal excreta + Crop residues + Earthworm	5.9	145.5	58.7
S.E.±	0.14	5.97	1.28
C.D. (P=0.05)	0.28	12.13	2.59

T_1= (Animal excreta under natural decomposition), T_2= (Animal excreta + earthworm and T_3= (Animal excreta + crop residues + earthworm)

Conclusion :

The results of study indicated that performance of poultry was maximum followed by goat and minimum was with duck. Similarly the methods of decomposition also influenced the yield and yield parameters of tomato and it was maximum with T_3 (Animal excreta + crop residues + earthworm) compared to other treatments.

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