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Nutrient partitioning in tomato grown on organic manure treated soil

Md. Yunus Miah*, **Md. Dhin Islam, Mohammed Ziauddin Kamal, Umme Sirajum Monira**[1]

Department of Soil Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh

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Abstract

Field studies focused on nutrient partitioning are necessary for the better crop growth and efficient use of manures. This work presents a comparative study of the effects of cow dung and urea as different N sources on plant growth, shoot-root dry weight and the concentrations of some nutritionally important elements in root, stem, leaf and fruit of tomato *(Lycopersicon esculentum* L., var. *Raton)*. A field study was conducted at the farm of BSMRAU campus, Gazipur with tomato in a Randomized Complete Block Design (RCBD) coupling four treatments. These were control and three N sources namely, cow dung (21.34 t ha^{-1}), urea (175kg N ha^{-1}), and half cow dung and half urea, respectively with four replications ensuring 175kg ha^{-1} N supply from both the sources. Cow dung yielded significant N, P, K, Ca, Mg accumulations in leaf, stem, root and fruit of tomato compared to urea. So if applied properly, cow dung could be a potential candidate to supplement urea as N source.

* **Corresponding Author:** Md. Yunus Miah ✉ miahyunus@ymail.com

Introduction

Tomato *(Lycopersicon esculentum* L., var. Raton*)* is one of the most popular vegetables in Bangladesh. With an average of 27342 hectares land under cultivation and the total production of tomato in Bangladesh are 368121 tones (BBS, 2016). So its average yield is very low compared to the average world yield (27 t/ha) (FAO, 2013). However, of the major vegetables grown in Bangladesh, tomato ranks 4th in terms of production.

Additionally, to keep the pace with the demand of vegetables owing to increase demographic pressure, the production of tomato should be increased too. These facts suggest that there is a great possibility to increase the tomato yield per unit area with the appropriate use of nitrogenous fertilizers because improper nitrogen source management (Islam, 2004) is one of the major reasons for low yield of tomato in Bangladesh. Apart from this, nitrogen fertilizer is the central element for agricultural development (Marschner, 1990) and nitrogen has the largest effect on the yield, flower formation and fruit setting and quality of tomato (Xin *et al.*, 1996; Monira *et al.*, 2007).

Additionally, nutrient content of plant organs (root, stem, leaf and fruit) provides information as the quantity of nutrient needed for physiological and metabolic processes (Mengel and Kirkby, 1982). Thus a net gain of nutrient owing to accumulation in plant parts may have detrimental effect on crop growth and development (Darst and David, 1991). On the other hand, organic manures exert a major role on crop production (Monira *et al.*, 2007). Later on, through a series of experiments owing to organic manure application on agricultural crops, (Noor *et al.*, 2001) and (Rahman *et al.*, 2005) confirmed that cow dung can be applied beneficially in agronomic and horticultural crop production. Despite the possible applications to agricultural crop production, no investigation up date has been carried out on the effects of cow dung as regards of nutrient partitioning in tomato so far. Therefore, the present study was undertaken to evaluate the contributions of cow dung on plant height, shoot-root dry weight and mineral content in root, shoot, leaf and fruit of tomato.

Materials and methods

Experimental site

The study was conducted at the farm of Department of Soil Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur in the agro-ecological zone (AEZ 28) of Modhupur tract.

Soil characters

The soil characters of the experimental site were silty clay loam having a pH (5.5), total nitrogen (0.054%) and organic matter (1.38%).

Physico-chemical properties of the used cow dung

Physico-chemical properties of the used cow dung were pH (7.1), total nitrogen (0.82%) and organic carbon (26.52%).

Land preparation and fertilization

Opened the land with a tractor, the land was ploughed and cross-ploughed for several times with a power tiller followed by laddering to bring the soil under good tilth conditions. The amounts of N, P, K, S and Mo at 175, 63, 20, 30 and 1kg/ha were applied through cow dung, urea, TSP, MOP, gypsum and sodium molybdate, respectively. However, urea and MOP were top dressed at two equal installments at 15 and 35 days, respectively after transplanting.

Experimental design and treatments

The experiment was laid out in a Randomized Complete Block Design (RCBD) comprising the treatment combinations T_1 (-cow dung, -urea), T_2 (cow dung +urea), T_3 (cow dung) and T_4 (urea) with four replications. The prepared block consisted of 16 plots with a unit plot size 5.76m^2 that accommodated 24 plants maintained at row to row and plant to plant distances of 60 cm and 40 cm, respectively.

Data collection

Root-shoot collection and data on plant growth and shoot-root dry weight and nutrient content in plant sample were determined by the methods of Roy (2008). For this, eight plants were randomly selected from each plot encompassing the avoidance of boarder effect.

Statistical analyses

The collected data on various parameters under study were statistically analyzed using MSTATC computer package program. The significance of differences among the pairs of treatments were evaluated by LSD test at 5% and 1% level of probability for interpretation of the results (Gomez and Gomez, 1984).

Results and discussion

Plant growth

Tomato plants grew well during the growing period in all of T_1, T_2, T_3 and T_4 treatments. However, the highest plant height at 30 DAT (Days after planting), 50% flowering and maturity stages over T_1 was noticed in T_4 only (Table 1). Presumably inorganic fertilization comprising NPK played a major role in plant height enhancement of tomato in T_4 as NPK fertilization at recommended doses improves plant height (Han and Misra, 1976). Significant ($p<0.001$) plant height both in T_3 and T_4 indicate that these treatments might play a similar role in the growth and development of tomato plant. In addition, similar trends of plant growth both in T_3 and T_4 facilitated the general agreement that cow dung as organic manure exerted beneficial effect on plant growth through nutrient and moisture supply (Gaur *et al.*, 1984). Further, Blondel and Blanc (1973) suggested that plants grow well at pH ranges 4-6 (Data not shown) and in the current investigation pH in all treatments lied 4.98 to 5.4. So another credible reason for similar trend of plant growth in both of T_3 and T_4 could be pH values.

Table 1. Effect of different treatments on plant height (cm) of tomato at different growth stages.

Treatment	30 DAT	50 % Flowering stage	Maturity stage
$T_{1(-N,\ -CD)}$	9.0	26.6	44.3
$T_{2(+N,\ +CD)}$	12.0	39.4	62.5
$T_{3(-N,\ +CD)}$	11.5	38.8	59.8
$T_{4(+N,\ -CD)}$	12.5	43.4	63.9
LSD	1.25	3.10	2.85
LS	**	**	**
CV (%)	6.95	5.23	3.08

N = Nitrogen, CD = Cow dung, LSD = Least significant difference, CV = Co-efficient of Variance, DAT = Days after transplanting, LS = Level of Significance.

Shoot-root dry weight

As shown in Table 2, there were significant variations ($p<0.001$) on shoot (stem and leaf) -root dry weights among the treatments. These appreciable variations among the treatments could be ascribed for the various N sources used. Namely, N fertilization results in the increase of shoot dry weight (Huet and Detmann, 1988; Kariszeweski *et al.*, 1987). Therefore, in this investigation both of T_4 and T_3 exerted major role to cause noticeable variations on shoot-root dry matter production as these sorts of treatments signify growth and development of tomato (Noor *et al.* 2001). Simultaneously remarkable is the fact that the highest shoot-root dry weight was found in T_3 and T_4, respectively. In particular, the shoot dry weight production in T_3 was pretty much higher compared to the other treatments. These findings are in agreement with those reported by (Gaur *et al.*, 1984). Because these authors clearly stated that the effect of cow dung on agricultural crops is not only significant but also dominant. These findings suggest that cow dung itself could be compatible to produce sufficient shoot-root dry mass as of most commonly and widely used urea fertilizer.

Table 2. Effect of different treatments on dry weight (g) of shoot and root of tomato.

Treatment	Dry weight (g)	
	Shoot	Root
$T_{1(-N,\ -CD)}$	840	4.22
$T_{2(+N,\ +CD)}$	1583	7.70
$T_{3(-N,\ +CD)}$	1850	6.71
$T_{4(+N,\ -CD)}$	1387	8.13
LSD	417	1.38
Level of significance	**	**
CV (%)	18.42	1.38

N = Nitrogen, CD = Cow dung, LSD= Least significant difference, CV = Co-efficient of Variance, DAT = Days after transplanting.

N, P, K, Ca and Mg accumulation in root, stem, leaf and fruit

Treatment combinations yielded significant ($p<0.001$) variations as regards of N, P, K, Ca and Mg accumulation in leaf, stem, root and fruit of tomato (Table 3). For example, the difference in N contents owing to different treatments could be ascribed for two reasons.

The first one is related to N sources used. Because we wanted to determine the variation of the amount of these elements in plant parts relevant to the cow dung as sole N source compared to that of urea.

This finding also revealed that cow dung (T_3) could not supplement urea at least for N accumulation in leaf, stem, root and fruit of tomato as accumulation trend was always higher in urea treatment (T_4). The second one is related to plant species as N content in plant parts vary from 2-5% regardless of N sources (Marschner, 1990). However, N content was high in root compared to shoot which was in full agreement with the findings of Han *et al.* (2016). Concerning the P concentration, the treatments showed significant ($p>0.005$) effect. However, highest P concentration in T_4 could be pretended for NPK effect (Miah *et al.,* 1999). On the contrary, P concentration in the same order (leaf>stem<root) both in T_2 and T_3 would seem to suggest that as N fertilizers both cow dung and urea would be of the same category. However, P accumulation in root, stem, leaf and fruit of tomato showed no definite trend in respect of treatments.

It was also evident from this investigation that P accumulation in root, stem, leaf and fruit as affected by T_4 was higher compared to other treatments. As shown in Table 3, the distribution of K in root, stem, leaf and fruit of tomato varied significantly ($p<0.005$). These sorts of variation in K contents of plant parts were in accordance with those reported by Marschner (1990). As this author confirmed such differential K contents in plant parts vary with N sources applied and plant species tested.

As for Ca and Mg, the same author in experiments with different plant species demonstrated that the differential Ca and Mg contents in plant parts occur due to different N sources. So the significant ($p<0.005$) variation of Ca and Mg content in root, stem and leaf of tomato as observed with different treatments T_1 (-cow dung, -urea), T_2 (cow dung +urea), T_3 (cow dung) and T_4 (urea) in the current experiments would be supportive of the findings stated by Marschner (1990). Meanwhile, pattern of Ca and Mg accumulation in tomato fruit would seem to fall in the suggestions of Kumar *et al.* (2007).

Table 3. Effect of different treatments on N, P, K, Ca and Mg concentration in root, stem, leaf and fruit of tomato plants at maturity.

Treatments	%																			
	Root					Stem					Leaf					Fruit				
	N	P	K	Ca	Mg	N	P	K	Ca	Mg	N	P	K	Ca	Mg	N	P	K	Ca	Mg
$T_{1(-N, -CD)}$	1.95	0.21	1.03	0.63	0.09	1.13	0.14	0.60	0.63	0.17	2.05	0.11	0.15	0.37	0.18	1.79	0.10	1.04	0.16	0.08
$T_{2(+N, +CD)}$	2.63	0.10	0.96	0.74	0.14	1.89	0.18	0.28	0.87	0.23	2.09	0.35	0.27	0.46	0.22	3.51	0.17	1.20	0.20	0.12
$T_{3(-N, +CD)}$	2.15	0.12	1.15	0.62	0.11	1.38	0.19	0.16	0.83	0.18	1.71	0.32	0.22	0.72	0.24	3.36	0.15	1.15	0.16	0.09
$T_{4(+N, -CD)}$	2.57	0.11	1.00	0.87	0.15	2.24	0.21	0.11	0.90	0.22	3.58	0.36	0.29	0.46	0.26	3.91	0.20	1.24	0.29	0.15
LSD	0.20	0.02	0.05	0.09	0.05	0.18	0.02	0.05	0.07	0.05	0.19	0.02	0.05	0.05	0.05	0.05	0.02	0.02	0.02	0.05
LS	**	*	**	**	**	**	**	**	**	**	**	*	**	**	**	**	**	**	**	**
CV (%)	5.41	9.45	3.89	0.26	7.73	6.80	7.01	0.66	5.94	6.62	5.07	3.87	1.38	2.53	4.32	1.06	12.12	1.48	4.14	4.52

N = Nitrogen, CD = Cow dung, LS = Level of Significance, LSD = Least significant difference, CV= Co-efficient of Variance,

** = significant at 1% level of probability, *= significant at 5% level of probability.

Conclusions

Based on the quantitative data presented in this article as regards of N source, it was evident that cow dung significantly affected plant growth, root-shoot dry weight and the N, P, K, Ca and Mg accumulation in root, stem, leaf and fruit of tomato. Thus, cow dung appeared to be compatible to urea as N source for tomato production.

References

BBS (Bangladesh Bureau of Statistics). 2016. Yearbook of Agricultural Statistics of Bangladesh. Bangladesh Bureau of Statistics. Statistics Division, Ministry of Bangladesh, Dhaka, Bangladesh pp. 125-139.

Blondel A, Blanc D. 1973. Influence of ammonium uptake and reduction in wheat plants. Academia Science (Paris), Series D. **277,** 1325-1327.

Darst BC, David W. 1991. Facts from Our Environment. Phosphorus and Potash Institute, Georgia, Atlanta. p15.

FAO. 2013. FAO Production Year Book. Basic Data Branch, Statistics Division, Rome, Italy **56.**

Gaur AC, Neelkanta S, Dragan KS. 1984. Organic manure-their nature and characteristics. Organic Manure, Publication and Information division, Indian Council of Agricultural Research, New Delhi 3-5.

Gomez KA, Gomez AA. 1984. Statistical Procedure for Agricultural Research, John Willey and Sons, New York.

Han I, Mistra RS. 1976. Effect of nitrogen, phosphorus and potassium on the growth and yield of tomato. Progress in Horticulture **7,** 45-52.

Han SH. An JY, Hwang J, Kim SB, Park BB. 2016. The effects of organic manure and chemical fertilizer on the growth and nutrient concentrations of yellow proplar (*Liriodendron tulipifera*) in a nursery system. Forest Science and Technology **12(3),** 137-143.

Huett DO, Datmann EB. 1998. Effect of nitrogen on growth, yield and nutrient uptake of tomatoes grown in sand culture. Australian Journal of Experimental Agriculture **28,** 391-399.

Islam MA. 2004. Effect of N fertilizer on nitrogen assimilation, physiological attributes and yield of potato. MS thesis, Faculty of Agriculture, BAU, Mymensingh.

Kariszeweski S, Elkner K, Rumpel J. 1987. Effect of nitrogen fertilization and irrigation on yield, nutrient status and quality of tomatoes under direct seeding. Acta Horticulture **200,** 195-202.

Kumar A, Kumar J, Ram B. 2007. Effect of inorganic and biofertilizer on growth, yield and quality of tomato. Progressive Agriculture **7(1/2).** 70-75.

Marschner H. 1990. Mineral Nutrition of Higher Plants. Academic Press, London 197-253.

Mengel K, Kirkby EA. 1982. Principles of Plant Nutrition. Academic Press p.12.

Miah MY, Chiu CY, Hayashi H, Chino M. 1999. Barley growth in response to potassium fertilization of soil with long term application of sewage sludge. Soil Science and Plant Nutrition **45,** 499-504.

Monira US, Miah MY, Mia MAB, Rahman GKM. 2007. Tomato fruit yield in response to organic manuring. J. Agril. Edu. Technol **10,** 93-98.

Noor S, Shil NC, Islam MM, Islam MA, Farid, ATM. 2001. Evaluation of organic manure and their efficient use on cabbage production. BARI Annual Report p.57.

Rahman MJ, Mallik SA, Khan MS, Begum RA, Islam MB. 2005. Effect of irrigation and nitrogen on tomato. BARI Annual report p.14.

Roy PK. 2008. Effects of organic manure on growth and yield in stem amaranth. MS thesis, Department of Soil Science, BSMRAU, Gazipur-1706.

Xin XY, Hui LJ, Lili H. 1996. The effect of NPK mixed application on yield and quality of tomato in solar green house. China Vegetables **4,** 10-13.