International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(6): 974-978

Received: 14-09-2018
Accepted: 18-10-2018

Anita Kumari
Deptt of Tree Improvement and Genetic Resources, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Bharti
Department of Basic Sciences, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Sunita Devi
Department of Basic Sciences, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

IK Thakur
Deptt of Tree Improvement and Genetic Resources, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Kritika Suman
Deptt of Tree Improvement and Genetic Resources, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Neeraj Sankhayan
Deptt of Tree Improvement and Genetic Resources, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Correspondence
Anita Kumari
Deptt of Tree Improvement and Genetic Resources, Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh, India

Effect of organic formulations on growth of mulberry (*Morus alba* L.) at nursery stage

Anita Kumari, Bharti, Sunita Devi, IK Thakur, Kritika Suman and Neeraj Sankhayan

Abstract
Indiscriminate use of chemical pesticides in modern agriculture resulted in the development of several problems such as pesticide resistant insects, resurgences of target and non-target pests, destruction of beneficial organism like honey bee, pollinators, parasites, and predators and pesticide residues in food and fodder. Crop + dairy is the predominant cultivating framework in the country practiced by over 70 % farm households. The abundant quantity of cattle excreta consisting of dung and urine is available at rural family. In spite of that only cow dung is utilized for manure and a significant amount of urine goes waste. Cattle urine is a good source of nitrogen, phosphate, potassium, calcium, magnesium, chlorite and sulphate. The influence of organic formulations has been well recognized on fruits and vegetables while such studies on fodder crops are rarely available. Mulberry is a high biomass producing fodder crop rich in protein content. Therefore keeping in view the importance of fodder crops the present study was undertaken. The treatments consist of cow urine decoction, cow urine, Jivamrit and sanjeevak at five different concentration along with control. Maximum height (150cm), leaf width (11.86cm) and leaf area (159.60cm^2) were recorded for treatment T2 (urine) with concentration C2 (40%). Maximum diameter (12.07cm) and maximum number of branches (5) were recorded for treatment T1 (cow urine decoction) with concentration C2 (40%). Maximum number of leaves (29.67), root length (71.83cm) and leaf length (21.16cm) were recorded for treatment T3 (Jivamrit) with concentration C3 (60%).

Keywords: organic formulations, mulberry, *Morus alba*

Introduction
Heavy use of chemicals in agriculture has weakened the ecological base in addition to degradation of soil, water resources and quality of the food. At this juncture a keen awareness has sprung on the adoption of "organic farming" as a remedy to cure the ills of modern chemical agriculture (Kannaiyan, 2000) [4]. With the increased awareness on organic farming among the farming community, they are using many organic formulations in crop production for increasing the yield. The indiscriminate use of chemical pesticides in modern agriculture resulted in the development of several problems such as pesticide resistant insects, resurgences of target and non-target pests, destruction of beneficial organism like honey bee, pollinators, parasites and predators and pesticide residues in food and fodder. The awareness about the health and environmental problems due to the continuous use of pesticides resulted in the development of integrated pest management (IPM) and organic farming (Thomas and Prabhu, 2001; Prabhu, 2004) [8, 13].

Crop + dairy is the predominant cultivating framework in the country practiced by over 70 % farm households. The abundant quantity of cattle excreta consisting of dung and urine is available at rural family. In spite of that only cow dung is utilized as manure and a significant amount of urine goes waste. However, cattle urine has a good manurial value and can be utilized as a bio fertilizer (Khanal *et al.,* 2010) [5]. Cattle urine is a good source of nitrogen, phosphate, potassium, calcium, magnesium, chlorite and sulphate. Application of cow urine has also been reported to correct the micro-nutrient deficiency, besides improving the soil texture and working as a plant hormone.

Vermiwash obtained from dissolution of organic matter by earthworm is additionally found as a good liquid manure and influence altogether on the development and productivity of crop as foliar spray (Subasashri, 2003) [12]. It is coelomic fluid extraction which contains several enzymes, plant growth stimulating hormones like cytokinins, gibberlines and vitamins along

with micro and macro- nutrients as nitrogen in the form of mucus, nitrogenous excretory substance etc (Tripathi and Bhardwaj, 2004) [14]. It also increases the disease resistant power of crop, (Yadav *et al.,* 2005) [19]. Neem seed extract performs the dual function of both fertilizer and pesticide of organic origin. It also acts as a soil enricher, reduces the growth of soil pest and bacteria. Moreover it provides macro-nutrients essential for all plant growth, helps to increase the yield of plants in the long run, bio-degradable and eco-friendly and excellent soil conditioner (Lokanadhan *et al.,* 2012) [6].

Mulberry is a high biomass producing and protein rich foliage plant with deep root system. However, with the prolonged exhaustion of nutrients, seasonal variabilities and nutrient imbalances associated with variable crop performance were noticed subsequently. Sustainable good quality mulberry leaf can be obtained continuously over a period of time by proper soil fertility management through continuous replenishment of nutrients by addition of fertilizers and manures. The quantity of manures and chemical fertilizers recommended for mulberry is quite high as compared to other agricultural crops. It is estimated that under tropical conditions, mulberry requires 20 MT of farmyard manure, besides 300 kg N, 120 kg P and 120 kg K per hectare per year for its optimum growth and yield. Hence, 60 per cent of the cocoons production cost goes for the mulberry leaf (Rangaswami *et al*., 1976) [10]. It is realized that part of the added fertilizers specially nitrogenous and phosphatic fertilizers are rendered unavailable to the plant soon after its application in soil due to various reasons such as leaching, fixation, volatization, *etc.* For some of the nutrient elements in the soil, root absorption is slow and translocation to shoot is poor under adverse soil conditions which favour fixation of nutrients. In order to avoid or minimize the severity of such conditions foliar application of nutrients is imperative (Qaiyyum and Bari, 1990) [9]. Organic manures replaced chemical fertilizers, herbal extracts replaced pesticides but nothing was available to replace the growth promoting hormones and immunity boosters for the plant. The plant growth stimulant defined in Vrkshayurveda, panchagavya was found to be the best in enhancing the biological efficiency of crop plants (Natarajan, 2002). During the advanced stage of decomposition of vermicompost, vermiwash collected by washing body of earthworms and its fecal matter by water act as a nutrient medium, plant growth stimulant and can be used as a prophylactic measures for controlling pest (Vikas Chandha, 2005) [18]. Keeping in view the importance of organic manures, the present investigation was conducted to study the effect of organic formulations on growth of *Morus* nursery plants.

Material and Methods

The study was conducted in 2018 in glass house of the Department of Tree Improvement and Genetic Resources. Cuttings of *Morus* were raised in month of January, 2018. From February onwards treatment were applied to the plants in different concentration at an interval of fifteen days.

Details of treatments and concentrations used

Four treatments i.e. T1 (Cow urine decoction prepared by using cow urine, leaves of eucalyptus, leaves of *Murraya* (Karipatta), and seeds of *Melia azedrach*), T2 (Cow urine), T3 (Jivamrit prepared by using cow urine, cowdung, Gram flour, Jaggery and forest soil) and T4 (Sanjeevak prepared by using cowurine, gram flour, and Jaggery) were used in different concentrations C1(20 %), C2(40%), C3(60%), C4 (80%) and C5 (100%) along with control as per the standard procedure.

The data were collected on different observations of nursery plants i.e, on plant height (cm), diameter (mm), number of branches, number of leaves per shoot, number of nodes, intermodal length and root length (cm). The data were statistically analyzed by using RBD (factorial effects vs single control treatment)

Results and Discussion

The results pertaining to the effects of formulations on height and diameter has been depicted in Table 1. An examination of the result revealed that height was found maximum in treatment T3 (jivamrit) which was statistically higher than all other treatments. Among concentrations maximum height (103.91cm) was recorded in concentration C2 (40%) which was statistically higher than all other treatments. However, minimum height (34.83cm) was recorded in the C5 i.e. 100% concentration. With respect to interaction effect between concentrations and treatments maximum height (150cm) was recorded treatment T2 (urine) with concentration C2 (40%) which is significantly higher than all other interactions. Minimum height (30cm) was recorded in the treatment T4 (sanjeevak) with concentration C5.

Table 1: Effect of formulations on height and diameter of plants

	Height (cm)						Diameter (cm)					
	T1	**T2**	**T3**	**T4**	**Mean**	**Control**	**T1**	**T2**	**T3**	**T4**	**Mean**	**Control**
C1	55.66	52.33	94.66	44.33	61.75	50.06	4.95	5.01	1.93	3.66	3.89	3.31
C2	150	117.66	94.33	53.66	103.91		12.07	6.92	2.70	2.80	6.12	
C3	74.66	49	132	39.66	73.83		7.56	2.18	10.67	2.51	5.73	
C4	62.33	42.66	35.66	41	45.41		4.1	2.61	3.11	4.03	3.46	
C5	43.33	27.66	38.33	30	34.83		3.63	2.26	3.20	2.80	2.97	
Mean	77.2	57.86	79	41.73			6.46	3.80	4.32	3.16	3.89	
CD	Treatments Concentrations Interactions Control vs others		1.24 1.38 2.77 2.01				0.14 0.16 0.32 0.23					

An examination of the result revealed that diameter was found maximum in treatment t1 (Cow urine decoction) which was statistically higher than all other treatments. Among concentrations maximum diameter (6.12cm) was recorded in C2 (40%) which was statistically higher than all other concentrations. However, minimum diameter (2.97cm) was recorded in the C5 (Table 1). With respect to interaction effect between concentrations and treatments maximum

diameter (12.07cm) was recorded in treatment T1 (cow urine decoction) with concentration C2 (40%) which is significantly higher than all other interactions. Minimum diameter (1.93cm) was recorded in the treatment T3 (jivamrit) with concentration C1 (20%).

Table 2: Effect of formulations on Number of leaves and no. of branches

	Number of leaves						No of branches					
	T1	**T2**	**T3**	**T4**	**Mean**	**Control**	**T1**	**T2**	**T3**	**T4**	**Mean**	**Control**
C1	7.66	13	8	5.33	8.5	7.33	0.33	1.33	0.33	0	0.5	0
C2	30.33	8	6	8.33	13.16		5	0.33	0	0.33	1.41	
C3	26	6	29.67	4.66	16.58		2.66	0	1	0.33	1	
C4	10	3	4.33	7	6.08		0.66	0	0	0.66	0.33	
C5	3.66	4.66	6.33	6.66	5.33		0	2.33	0.33	0.667	0.83	
Mean	15.53	6.93	10.86	6.4			1.73	0.8	0.33	0.4	mean	
CD	Treatments		0.90				NS					
	Concentrations		1.01				0.96					
	Interactions		2.02				1.92					
	Control vs others		NS				1.39					

The results pertaining to effects of formulations on number of leaves and number of nodes has been depicted in Table 2. An examination of the result revealed that number of leaves was found maximum in treatment T1 which was statistically higher than all other treatments. Among concentrations maximum mean number of leaves (16.58) was recorded in concentration C3 which was statistically higher than all other clones. However, minimum number of leaves (5.33) was recorded in C5. With respect to interaction effect between concentrations and treatments maximum mean numbers of leaves (29.67) were recorded in treatment T3 with concentration C3 which is significantly higher than all other interactions. Minimum numbers of leaves (3) were recorded in the treatment T2 with concentration C4. An examination of the results revealed that number of branches was found maximum in treatment T1 which is statistically higher than all other treatments. Among concentrations maximum number of branches (1.41) was recorded in concentration C2 which was statistically at par with C1 (0.5), C5 (0.83) and C3 (1). However, minimum number of branches (0.33) were recorded in C4. With respect to interaction effect between concentrations and treatments maximum number of branches (5) were recorded treatment T1 with concentration C2 which was significantly higher than all other interactions. Minimum number of branches (0) were recorded in the treatment T4 with concentration C1, treatment T3 with concentration C2, treatment T2 with concentration C3, treatment T2 with concentration C4, treatment T3 with concentration C4 and treatment T1 with concentration C5. Venkataramana *et al*, 2009 [17] also reported that use of vermiwash significantly increased the leaf yield, plant height, shoot length, number of branches and number of leaves per plant in mulberry. Uppar (2011) [16] also reported that foliar spray of vermiwash at 5% concentration increased the growth of mulberry.

Table 3: Effect of formulations on root length and leaf length

	Root length(cm)						Leaf length(cm)					
	T1	**T2**	**T3**	**T4**	**Mean**	**Control**	**T1**	**T2**	**T3**	**T4**	**Mean**	**Control**
C1	22.5	22.16	62.16	12.66	29.87	13.66	12.53	17.83	15.46	18.26	16.02	14.33
C2	49.16	44.16	61.16	14.33	42.20		20.6	24.8	17.3	20.36	20.76	
C3	39.5	13.16	71.83	10	33.62		14.33	13.13	21.16	15.66	16.07	
C4	16.16	13.5	20.16	11.16	15.25		14.16	12.66	15.16	15.33	14.33	
C5	14.75	13.83	18.66	9.16	14.10		13.53	13.63	15.66	15.43	14.56	
Mean	28.41	21.36	46.8	11.46			15.03	16.41	16.95	17.01		
CD	Treatments		0.72				0.19					
	Concentrations		0.80				0.22					
	Interactions		1.61				0.44					
	Control vs others		1.17				0.31					

The results pertaining to the effect of formulations on root length has been given in Table 3. An examination of the result revealed that root length was found maximum in treatment T3 which was statistically higher than all other treatments. Among concentrations maximum root length (42.20cm) was recorded in concentration C2 which was statistically higher than all other concentrations. However, minimum root length (14.10cm) was recorded in the C5. With respect to interaction effect between concentrations and treatments maximum root length (71.83cm) was recorded in treatment T3 with concentration C3 which is significantly higher than all other interactions. Minimum root length (9.16cm) was recorded in the treatment T4 with concentration C5. The results pertaining to the effect of formulations on leaf length has been presented in Table 3. An examination of the results revealed that leaf length was found maximum in treatment T4 which was statistically at par with treatment T3. Among concentrations maximum leaf length (20.76cm) was recorded in concentration C2 which was statistically higher than all other concentrations. However, minimum leaf length (14.33cm) was recorded in the C4. With respect to interaction effect between concentrations and treatments maximum leaf length (21.16cm) was recorded in treatment T3 with concentration C3 which was significantly higher than all other interactions. Minimum leaf length (12.53cm) was recorded in the treatment T1 with concentration C1.

Table 4: Effect of formulations on Leaf width and leaf area

	Leaf width(cm)						Leaf area (cm^2)					
	T1	T2	T3	T4	Mean	Control	T1	T2	T3	T4	Mean	Control
C1	8	8.5	8.33	9.46	8.57	7.43	54.64	72.91	58.84	84.89	67.82	51.61
C2	10.33	11.86	10.4	9.6	10.55		112.89	159.60	93.74	107.56	118.44	
C3	8.4	6.73	10.4	7.5	8.25		61.79	40.59	112.16	60.86	68.85	
C4	7.7	7.36	9.23	8.33	8.15		56.66	46.73	65.59	55.36	56.08	
C5	8.4	8.56	9.4	7.36	8.43		58.41	55.91	65.93	53.21	58.36	
Mean	8.56	8.60	9.55	8.45			68.88	75.15	79.25	72.37		
CD	Treatments		0.17				2.30					
	Concentrations		0.19				2.57					
	Interactions		0.391				5.14					
	Control vs others		0.28				3.72					

The results pertaining to the effect of formulations on leaf width and leaf area has been given in Table 4. An examination of the result revealed that leaf width was found maximum in treatment T3 which was statistically higher than all other treatments. Among concentrations maximum leaf width (10.55cm) was recorded in concentration C2 which was statistically higher than all other concentrations. However, minimum leaf width (8.15cm) was noted in the C4. With respect to interaction effect between concentrations and treatments maximum leaf width (11.86cm) was recorded in treatment T2 with concentration C2 which was significantly higher than all other interactions. Minimum leaf width (7.36cm) was founded in the treatment T4 with concentration C5. Leaf area was found maximum in treatment T3 which was statistically higher than all other treatments. Among concentrations maximum leaf area (118.44 cm^2) was recorded in concentration C2 which was statistically higher than all other concentrations. However, minimum leaf area (56.08cm^2) was recorded in the C4. With respect to interaction effect between concentrations and treatments maximum leaf area (159.60cm^2) was recorded in treatment T2 with concentration C2 which was significantly higher than all other interactions. Minimum leaf area (40.59cm^2) was noticed in treatment T2 with concentration C3. Rawgol *et al.,* (2011) [11] studied the integrating aspects of Vermiculture, Moriculture and Sericulture. The products of vermiculture, including the vermicompost, vermicompost extract, vermicompost brew and the extracted body fluid of earthworms, the vermiwash were found to significantly increase the growth parameters of the mulberry plant and enhance the nutritive level of the mulberry leaves. Such leaves fed to the silkworm larvae (*Bombex mori* L) showed a significantly positive effect on larval growth. Ugale (2014) [15] reported higher productivity and profitability of soybean-wheat cropping sequence. General recommended dose of fertilizer (GRDF), followed by 50% recommended dose of nitrogen (RDN) through farmyard manure+ 50% RDN through vermicompost+Jeevamrut two times is advisable for wheat-soyabean cropping system. Beaulah (2001) [1] reported that total dry matter of *Moringa* spp. increases by spraying panchgavya which facilitate instant uptake of nutrients. Similar work was also carried out by Boraiah *et al* (2017) [2] on capsicum and Bhat *et al*, (2017) [3] on Litchi.

Conclusion

On the basis of the results of the present study use of cow urine at 40 % concentrations gave maximum height, leaf width, and leaf area, while Jivamrit at 60 % concentrations gave maximum number of leaves, root length, and leaf length.

Acknowledgement

The authors are thankful to Prof & Head, Department of Tree improvement and Genetic Resources, Dr YS Parmar University of Horticulture and Forestry Nauni, Solan for providing laboratory and field facilities during the course of these investigations

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