The Pharma Innovation Journal 2021; 10(12): 572-574

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 572-574

www.thepharmajournal.com
Received: 02-09-2021
Accepted: 29-11-2021

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Effect of various combination of Moringa leaf extract on germination and foliage yield attributes in coriander (*Coriandrum sativum* L.)

Poonam Tiwari and Bhagwat Saran Asati

Abstract
Moringa Leaf Extract (MLE) significantly improved the growth parameters and foliage yield in coriander under study. Among the parameters under study, treatment ML extract 4% + Cow urine 5% + Cow dung 5% (fermented) showed higher number of leaves/plant, number of branches/plant, stem base diameter, root length, root diameter, fresh plant weight, dry plant weight, fresh leaves weight, dry leaves weight, fresh stem weight, dry stem weight, fresh root weight, dry root weight, leaf stem ratio, foliage yield, vigour index and harvest index, while treatment ML extract 4% + GA3 0.03% (fresh) was found most effective for germination percentage and plant height. It is therefore suggested that fermented Moringa leaf extract (4%) combined with organic boosting substances cow dung (5%) and cow urine (5%) acts to increase growth in coriander.

Keywords: Coriander, bio-stimulant, GA3, Moringa leaf extract (MLE), germination and foliage yield

Introduction
Moringa (*Moringa oleifera* Lam) belongs to the family Moringaceae. It is a very nutritious multipurpose plant that is used to fresh vegetables, animal fodder, green manure, biogas, medicine, biopesticide, and seed production (Fugli, 1999) [8]. Now the day's intensive use of chemical fertilizers causes soil degradation, environmental pollution and increases the production costs. There are many natural bio stimulants used for improving the growth and productivity of different crops. Among them, moringa leaf extract (MLE) obtained from moringa (*Moringa oleifera*, Lam) engaged more attention. Moringa leaf extract (MLE) is a good plant growth enhancer because it is high in amino acids, potassium, calcium, iron, ascorbic acid and growth regulating hormones like zeatin (Makkar & Becker, 1996 and Basra *et al.*, 2011) [10, 1]. The use of Moringa leaf extract along with organic substances can provide an environment safe, easily accessible, and cheap technique of enhancing crop yield. Seed germination rate and seedling growth in coriander are very low compared to the other vegetable crop seedlings. The above fact the present experiment was planned to know the effect of various combination of Moringa Leaf Extract (MLE) on germination and foliage yield attributes in coriander (*Coriandrum sativum* L.).

Materials and Methods
The experiment was carried out in Randomized Block Design with eight treatments and three replications under field condition at Pt. Kishori Lal Shukla College of Horticulture and Research Station, Rajnandgaon (C.G.) during the year 2020-21. The treatments consist of organic sources of plant nutrients and their combination with Moringa leaves in the present experiment i.e. T_1 (MLE 4%), T_2 (MLE 4% +Vermiwash 2.5%), T_3 (MLE 4% + GA3 0.0.3%), T_4 (MLE 4% + cow urine 5%), T_5 (MLE 4% + cow dung 5% + cow urine 5%), T_6 (MLE 4% + neem leaves extract 4%), T_7 (MLE 4% + cow urine 5% + neem leaves extract 4%) and T_8 (control/water spray). The size of the experiment plot was 75 x 75 cm and the seeds were sown at a distance of 10 cm between rows and 8cm between the plants. Recommended dose of fertilizers and other cultural packages of practice were adopted for raising good crop. Five plants were selected randomizing from each plots to record observations on various growth and foliage yield characters. The data recorded during the course of experimentation were subjected to statistical analysis of Randomized Block Design as described by Panse and Sukhtame (1978) [12]. Analysis of variance was done by the method described by Fisher (1925) [7].

Results and Discussion

Observations related to germination percentage is exhibited in Table 1. Significantly higher germination percentage was noted in treatment T_3 (MLE 4% + GA3 0.0.3%) (93.01%), whereas minimum germination percentage was observed in treatment T_8 (control/water spray) (70.25%). This results support the finding of Debbarma *et al.* (2018) [4] in coriander and chilli, Yungandhar *et al.* (2017) [15] in coriander. They observed that the increasing germination percentage due to seed soaked with GA3 which increase the synthesis of various enzyme such as α- amylase, protease and help remove the physical barriers associated with the seed coats. Table 1 showed that the plant height was also found maximum in treatment T_3 (MLE 4% + GA3 0.0.3%) (16.31) and minimum was recorded in the treatment T_8 (control/water spray) (10.25) when compared to the other treatments. The increase plant height may be due to increased plasticity of the cell wall and external use of GA3 and MLE which enhance the process of cell division and cell enlargement which favours increased inter nodal length, ultimately increasing plant height. The result was supported by with Yungandhar *et al.* (2017) [15] and Das *et al.* (2018) [3].

Table 1 showed that the significantly higher number of leaves/plants (32.67) and number of branches/plant (8.30), fresh plant weight (11.54g) and dry plant weight (0.931g) were observed in treatment T_5 (MLE extract 4%+ Cow urine 5% + Cow dung 5%), whereas lowest was observed in treatment T_8 (Control/water spray). Culver *et al.* (2012) [2] and Das *et al.* (2018) [3] reported the that the use of GA3, MLE, cow urine and cow dung contains some plant growth hormones like auxin, cytokinin and other macro and micro nutrients which enhance physiological activities of plant, resulting induces more number of leaves and more number of branches/plants and increase plant weight.

Stem base diameter was noted highest in treatment T_5 (MLE extract 4% + Cow urine 5% + Cow dung 5%) (0.587), while lowest in T_8 (0.323) control/water) under the study (Table 1). In similar result reported by Williams *et al.* (2018) [14] in maize, who found that photosynthesis rate, stem surface will increase with increase MLE consequently resulting in higher stem base diameter. On other hand, maximum root length (9.61cm), root diameter (1.167cm) was also recorded in treatment T_5 (MLE extract 4% + Cow urine 5% + Cow dung 5%) and minimum root length (5.98cm), root diameter (0.737cm) was noted in treatment T_8 (control/water spray). Sharma (2020) [13] reported that the root length increase may be due to use of MLE which contain phosphorous, natural cytokinin, that responsible for cell division and cell elongation of root cell and promoted root development and increased the nutrients uptake through roots.

Table 2 exhibited that the maximum fresh leaves weight (5.76g) and dry leaves weight (0.791g) was found significantly higher in treatment T_5 (MLE extract 4% + Cow urine 5% + Cow dung 5%), on other hand minimum fresh leaves weight (1.19g) and dry leaves weight (0.196g) was recorded in treatment T_8 (Control/water spray). Elumalai *et al.* (2013) [6] and Hoque *et al.* (2020) [9] observed that the increasing fresh weight of leaves is due to foliar spray of MLE, cow urine and vermiwash, vermiwash contains sugars, phenols, amino acid and cow urine contains growth promoting hormones auxin which stimulate leaf area and vegetative growth of plant.

Among the eight treatments, treatment T_5 (MLE extract 4% + Cow urine 5% + Cow dung 5%) exhibited statistically higher fresh stem weight (5.13g), dry stem weight (0.695g), fresh root weight (0.677g) and dry root weight (0.605g), whereas the untreated plant treatment T_8 (control/water spray) showed the lowest fresh stem weight (1.70g), dry stem weight (0.168g), fresh root weight (0.196g) and dry root weight (0.146g) under study (Table 2). Increasing the fresh stem weight of plant might be due to the presence of auxin and nutrients in cow urine which leads to increase growth parameters of plants. These similar results were in close with Desai *et al*. (2017) [5] and Pal *et al.* (2019) [11].

Under the present investigation, significantly higher foliage yield was observed in treatment T_5 (MLE extract 4% + Cow urine 5% + Cow dung 5%) (0.808kg/plot), while minimum foliage yield was observed in treatment T_8 (0.216kg/plot) as presented in Table 2**.** Das *et al.* (2018) [3] found that the use of MLE, cow dung, cow urine and GA3 resulted in an increase in leaf yield due to increase in growth, photosynthesis rate and other metabolic activities. Table 2 also showed that the, treatment T_5 (MLE extract 4% + Cow urine 5% + Cow dung 5%) recorded highest leaf stem ratio (1.124), vigour index (2366.57) and harvest index (49.93), while treatment T_8 (control/water spray) showed the lowest leaf stem ratio (0.671), vigour index (1149.68) and harvest index (35.55) among the treatments under the study.

Table 1: Effect of various treatments on growth and foliage yield parameters in coriander crop

Treatments	Germination%	Plant height (cm)	No. of leaves/ plants	No. of branches/plants	Stem base diameter (cm)	Fresh plant weight (gm)	Dry plant weight (gm)	Root length (cm)	Root diameter (cm)
T_1 (MLE 4%)	83.33	11.39	18.65	6.50	0.353	3.94	0.451	7.79	0.833
T_2 (MLE 4% + Vermiwash 2.5%)	86.88	13.68	29.53	6.27	0.337	4.78	0.717	7.41	0.890
T_3 (MLE 4%+ GA3 0.03%)	93.01	16.31	20.46	5.35	0.437	5.31	0.647	6.40	0.787
T_4 (MLE 4% + Cow urine 5%)	89.03	12.55	27.18	5.59	0.313	6.05	0.767	6.88	0.881
T_5 (MLE extract 4%+ Cow urine 5% + Cow dung 5%)	91.33	15.59	32.67	8.30	0.587	11.54	0.931	9.61	1.167
T_6 (MLE 4% + Neem leaves extract 4%)	90.69	13.23	22.34	5.69	0.451	5.15	0.683	7.25	0.803
T_7 (MLE 4% + Cow urine 5% + Neem leaves extract 4%)	90.33	14.16	31.41	7.50	0.533	9.17	0.837	8.42	0.963
T_8 (Control/Water spray)	70.25	10.25	15.72	5.41	0.323	3.08	0.260	5.98	0.737
Mean	78.13	13.39	24.74	6.32	0.41	6.13	0.66	7.42	0.88
CV	4.824	9.556	7.197	9.976	11.763	8.126	10.30	11.71	15.26

Table 2: Different leaf yield parameters affected by treatments in coriander crop under study

Treatments	Fresh leaves weight (gm)	Dry leaves weight (gm)	Fresh stem weight (gm)	Dry stem weight (gm)	Fresh root weight (gm)	Dry root weight (gm)	Harvest index	Vigour index	Leaf stem ratio	Foliage yield (kg/plot)
T_1 (MLE 4%)	1.40	0.313	2.11	0.257	0.443	0.202	38.25	1608.45	0.697	0.276
T_2 (MLE 4% + Vermiwash 2.5%)	2.06	0.351	2.33	0.298	0.383	0.273	43.25	1833.43	0.887	0.335
T_3 (MLE 4%+ GA3 0.03%)	2.03	0.337	3.06	0.264	0.216	0.246	38.24	2112.06	0.667	0.372
T_4 (MLE 4% + Cow urine 5%)	2.76	0.353	3.03	0.321	0.258	0.306	45.70	1734.53	0.918	0.424
T_5 (MLE extract 4%+ Cow urine 5% + Cow dung 5%)	5.76	0.791	5.13	0.695	0.677	0.605	49.93	2366.57	1.124	0.808
T_6 (MLE 4% + Neem leaves extract 4%)	2.30	0.341	2.56	0.281	0.289	0.261	44.55	1858.05	0.895	0.361
T_7 (MLE 4% + Cow urine 5% + Neem leaves extract 4%)	4.31	0.545	3.96	0.453	0.575	0.384	46.83	2040.50	1.088	0.642
T_8 (Control/Water spray)	1.19	0.196	1.70	0.168	0.196	0.146	35.55	1149.68	0.671	0.216
Mean	2.72	0.403	2.61	0.342	0.373	0.302	42.79	1837.86	0.868	0.429
CV	9.915	9.229	8.957	9.185	9.974	9.019	5.15	8.592	8.824	8.126

Conclusion

This experiment suggests that seed soak and foliar application of MLE in coriander had significant positive effects on vegetative growth parameters. Among the parameters under study, treatment T_5 ML extract 4% + Cow urine 5% + Cow dung 5% (fermented) showed higher number of leaves/plant, number of branches/plant, stem base diameter, root length, root diameter, fresh plant weight, dry plant weight, fresh leaves weight, dry leaves weight, fresh stem weight, dry stem weight, fresh root weight, dry root weight, leaf stem ratio, foliage yield, vigour index and harvest index, while treatment T_3 ML extract 4% + GA3 0.03% (fresh) was found most effective for germination percentage and plant height. It is therefore suggested that fermented Moringa leaf extract (4%) combined with organic boosting substances cow dung (5%) and cow urine (5%) acts to increase growth in coriander crop.

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