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Organic Manure As An Alternative To The Conventional Mineral Fertilizers In Cultivation Of *Digitalis Purpurea* L.

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Abstract: *Digitalis purpurea* L. commonly known as foxglove or *tilpuspi* is an important medicinal (presence of cardiac glycosides in leaves) and ornamental plant (purple and white coloured flowers) . The present experiment was conducted aiming to improve the yield and plant growth without leaving any adverse impact on soil and surrounding. For this experiment different organic manures were used as solo and in combination with each other and performance were compared with the recommended dosage of mineral fertilizers and plant grown without fertilizer. The experiment was layout in randomized block design with twelve treatments and three replications of each treatment. Vermicompost individually and in combination with mineral fertilizers and other manures showed significant effect on growth and yield traits. It was observed that 100% dosage of vermicompost significantly increases the number of leaves (10.88 and 31.88) and leaf length (13.42 and 24.04cm) during both seasons respectively. It also increases the leaf dry yield (351.57g/plot) during second season of plant growth. Whereas in combination of vermicompost and litter compost in 1:1 enhances the leaf fresh weight (139.98 and 456.10 g/plot) during both seasons respectively and leaf dry weight during first season of plant growth. Moreover, it was observed that vermicompost in combination with the farmyard manure increases the leaf area (63.64 and 67.16cm^2) during both seasons. Leaf width (8.34 and 9.61cm) was found enhanced by the application of farmyard manure. The results obtained reflected the superiority over the mineral fertilizers significantly for the major yield attributing traits, indicates that organic manures can successfully replace mineral fertilizers without adversely affecting the growth and yield of crop plant. They not only enhance the growth, yield and quality of plants but also show positive effect on soil health without any residual effect unlike mineral fertilizers.

Keywords: Organic farming, vermicompost, farmyard manure, compost, *Digitalis purpurea*

Introduction

Medicinal plants had been an integral part of the Indian civilizations from ages. Various medicinal systems form a strong base and vast history for the utilization of medicinal plants. Apart from the medicinal use these plants are also used in various traditional ceremonies, religious offerings, for ornamental and aesthetic purpose (Verma *et al.,* 2018). In India the demand of herbal raw material was estimated around 1,95,000 MT during 2014-15 and total domestic consumption was estimated around 12,000MT. It was also reported that only 22% of total herbal raw material is sources through cultivation and rest is collected from natural sources (NMPB, 2019). Currently India is the 2nd largest producer and exporter of herbal raw produce, having varied climatic conditions it has potential to be the world largest producer and exporter of herbal raw products (Kalauni and Joshi, 2018). The aim of cultivation of medicinal plants is to increase the uniformity and concentration

bioactive constituents. In the process of agriculture development, the share of organic manure fertilizer as a source of nutrient to plants constantly decreases and use of synthetic fertilizers continuously increases. In long term it had been reported that, continuous use of mineral fertilizers deteriorates the physical and chemical properties of soil (Kewalanand and Prajapati, 2018). Considering cultivation techniques of medicinal plants is little different from conventional crop production as medicinal plants are cultivated solely for the secondary metabolites present in them and not for direct consumption. With this nature of medicinal plant cultivation concept of good agriculture practices (GAPs) recommended by WHO came into existence. In GAPs it is advices that, for the quality produce medicinal plants if no scientifically documented methods are available medicinal plants should always be cultivated organically by traditional methods (Saini *et al.,* 2007). Organically grown medicinal and aromatic plants are not only easily acceptable in world market but also give higher returns. It had been reported that the active content present in medicinal plants are differently modified by the presence of complex nutrient in the environment (Aishwath *et al.,* 2003). Digitalis is a genus consisting of about 20 species representative of many medicinal ornamental plants which are used in preparation of herbal medicines. This genus is placed in the figwort family Plantaginaceae (Al-Snafi., 2017). *Digitalis pupurea* L. (Common foxglove or Purple foxglove or *tilpushpi*) is one of the economically and medicinally important species due to the presence of cardiac glycosides present in leaves, used in life-saving medicines (Withering, 2014; Verma *et al.,* 2016). *Digitalis purpurea* is an herbaceous annual or biennial in nature. It grows erect, and remains rosette during the first season before the flowering stalk grows up. The plant produces about 0.2-0.4% in *D. pupurea* (Kumar, 2013). It consists of lanatoside A,B,C which on hydrolysis produces four important glycosides of which three are cardiac stimulants Digitoxin, Gitoxin, Digitonin (Patil *et al.,* 2012). Traditionally it is used for the treatment of headaches, ulsers, boils and paralysis. It was also found effective in poorly healing wounds (Al-Snafi, 2017).

Materials and Methods

Present study was carried out at field station (*Banyakund, Rudrapryag*) of High Altitude Plant Physiology Research Centre, School of Agriculture and Allied Sciences, HNB Garhwal University (A Central University) Srinagar Garhwal, Uttarakhand (India). The experiment was laid out in Randomized Block Design with twelve treatments and three replications each treatment. Seed were collected from medicinal and aromatic plant block of College of Horticulture (VCSG, UUHF). The seeds were sown in nursery and transplanted in main field after attains height of 10-15cm. The treatments were applied to the different plots before transplanting. The treatment includes T1 Control (No Treatment) T2-Recommended dosage of FYM and fertilizer (FYM 10T/ha and 20:30:30 Kg/ha of NPK), T3-75% of recommended dosage+vermicompost (VC), T4-50% of recommended dosage+vermicompost, T5-25% of recommended dosage+Vermicompost, T6-Vermicompost (VC) (2Kg/Plot), T7-Farm Yard manure (FYM) (3.5Kg/Plot) T8-litter compost (L) (4Kg/Plot), T9-FYM+VC (1.7Kg+1Kg/Plot), T10-L + VC (1Kg+2Kg/Plot), T11-FYM + L (1.75Kg+2Kg/Plot), T12-VC + FYM + L (.5Kg+.3Kg+1.3Kg/Plot). Observations recorded i.e. Plant height (cm), Number of leaves, Leaf length (cm), Leaf width (cm) Leaf area (cm^2), Fresh and dry leaf weight (g), Number of flowering spike, Length of flowering spike (cm), Fresh and dry yield per plot (g) were recorded during vegetative and flowering initiation stage of plant. The mean

values for the observation were worked out for the analysis of variance (P=0.05).

Results

From the present investigation it was observed that organic manuring significantly affects the growth and yield. It was reported that among all the organic amendments vermicompost and vermicompost in combination with other organic manure shows significant higher growth and yield of plant. The increase in the growth and yield of the plant was found significantly higher than that of the plant grown under mineral fertigation. Vermicompost significantly increases the number of leaves in both the season and fresh and dry yield during second season (775.93g and 351.57g respectively) the increase in yield was found at par with the treatment application of farmyard manure (718.91g and 318.48g respectively). Whereas in combination with litter compost it enhances the leaf fresh weight (9.58g and 14.79g), leaf dry weight (3.90g and 5.93g) at both season. Moreover it was observed that vermicompost in combination with the farm yard manure increases the leaf area (63.63cm^2) during the first season and during second season it was found highest in treatment of litter compost (70.26cm^2). Leaf width was found enhanced by the application of farm yard manure (8.34cm and 9.61cm) during both the season. Leaf length was found highest by the application of vermicompost (13.43cm) whereas, it was found highest by the application of recommended dosage of nutrient in second season (24.77cm). Plant highest was observed highest by application of 25% recommended dosage and vermicompost in first season (20.74cm) whereas in second season it was highest in treatment combination of farmyard manure and litter compost (42.96cm). The number and length of flowering spike was highest in plant supplied with 50% recommended dosage and vermicompost (4.61 and 157.10 cm).

Discussion

The application of vermicompost, farm yard manure, litter compost their combinations and vermicompost in combination with NPK fertilizers shows significant variations for the various morphological traits under study than plant grown under recommended dosages of fertilizer and no fertilizer conditions. In the present investigation it was observed that during first season of crop growth vermicompost significantly increases the plant height, leaf number and leaf length whereas leaf area was increased by the combined application of vermicompost and farm yard manure. Leaf width and leaf fresh weight was observed highest in plant treated with the full dosage of farm yard manure.

Moreover yield attributing characters leaf dry weight, fresh yield/plot and dry yield/ plot was increases by the application of combined application of vermicompost with the litter compost. Similarly for the second season of plant growth vermicompost effectively increases the Leaf number, leaf length fresh yield and dry yield per plot which contributes directly to the yield. Along with it vermicompost in combination with NPK fertilizers significantly increases the number of flowering spike and length of flowering spike which was statistically at par with the treatment of vermicompost.

Table 1:- Effect of organic amendments on growth traits of *Digitalis purpurea* L.

Treatments	Plant height (cm) ± SE(m)		Number of leaves per Plant (Count) ± SE(m)		Leaf length (cm) ± SE(m)		Leaf width (cm) ± SE(m)		Leaf area (cm^2) ± SE(m)	
	Season I	Season II	Season I	Season II	Season I	Season II	Season I	Season II	Season I	Season II
T1	12.25± 0.86	25.27± 0.50	5.44±0 .29	24.11± 1.06	11.20± 0.59	13.54± 0.81	6.64± 0.55	6.65± 0.26	33.19± 0.54	39.83± 1.13
T2	14.97± 1.35	25.97± 0.46	6.77±0 .86	27.44± 0.72	13.05± 0.59	24.77± 0.58	6.86± 1.20	8.21± 0.12	38.34± 0.86	45.32± 1.14
T3	15.55± 1.37	26.38± 0.49	9.66±1 .76	27.22± 0.96	10.77± 0.58	21.80± 0.31	7.66± 1.47	9.16± 0.26	36.12± 0.61	42.77± 0.73
T4	18.17± 1.42	27.72± 0.31	9.66±0 .33	27.00± 1.71	10.40± 0.75	19.63± 0.23	6.31± 0.58	5.55± 0.42	30.60± 1.27	37.92± 1.11
T5	20.74± 0.43	29.15± 0.26	9.44±0 .72	23.77± 1.16	8.49±0. 64	17.58± 0.73	7.06± 0.85	7.07± 0.37	32.33± 0.87	38.97± 1.28
T6	16.47± 2.20	29.61± 0.35	10.88± 1.97	31.88± 0.44	13.42± 1.06	24.04± 0.58	6.72± 1.33	8.60± 0.10	49.26± 0.52	55.91± 0.92
T7	12.88± 0.33	31.57± 0.35	6.44±0 .11	25.88± 0.94	12.28± 0.46	19.74± 0.55	8.34± 0.87	9.61± 0.52	51.53± 1.09	40.18± 3.04
T8	13.44± 0.90	41.13± 1.21	7.55±1 .06	28.88± 1.39	11.75± 0.34	19.18± 0.58	6.44± 0.48	6.36± 0.25	45.11± 0.88	70.28± 2.02
T9	13.15± 1.37	39.56± 0.31	7.22±0 .90	31.33± 0.57	12.27± 0.71	19.22± 0.44	7.71± 0.55	7.64± 0.40	63.64± 1.03	67.16± 1.79
T10	14.71± 1.13	36.25± 0.52	10.66± 0.19	31.55± 0.80	10.43± 0.68	20.61± 0.71	7.42± 1.24	8.95± 0.15	59.85± 1.64	51.75± 1.60
T11	13.28± 1.90	42.96± 0.34	6.66±0 .57	29.11± 1.17	11.90± 0.74	15.16± 0.56	5.67± 0.50	5.67± 0.28	53.95± 1.46	60.59± 1.39
T12	12.63± 0.72	39.34± 0.15	8.11±0 .72	29.11± 0.72	12.27± 0.84	18.01± 0.33	7.87± 0.49	7.21± 0.67	37.18± 0.04	43.83± 0.73
CD	03.77	1.55	02.97	3.14	1.53	1.67	1.42	1.05	3.91	3.93
SE(m)	01.28	0.52	01.00	1.06	0.52	0.56	0.48	0.35	1.32	1.33
SE(d)	01.81	0.74	01.42	1.50	0.73	0.80	0.68	0.50	1.87	1.88
CV	14.92	2.77	21.26	6.56	7.83	5.05	11.86	8.19	5.19	4.65

CD value is calculated at 5% level of significance

T2-Recommended dosage of FYM+NPK, T3-75% Recommended Dosage+ 25% Vermicompost, T4-Recommended Dosage+ 50% Vermicompost, T5-25% Recommended Dosage+ 75% Vermicompost, T6-Vermicompost (100%), T7-Farm Yard Manure (100%), T8-Litter Compost (100%), T9-Vermicompost + Farm Yard Manure (50+50%), T10-Vermicompost + Litter Compost (50+50%), T11-Farm Yard Manure + Litter Compost (50+50%), T-12Vermicompost + Farm Yard Manure + Litter Compost (1/3 each)

Table 2:- Effect of organic amendments on growth and yield traits of *Digitalis purpurea* L.

Treatments	Leaf fresh weight (g/leaf) ± SE(m)		Leaf dry weight (g/leaf) ± SE(m)		Number of flowering spike per plant	Length of flowering spike (cm)	Fresh yield (g/plot) ± SE(m)		Dry yield (g/plot) ± SE(m)	
	Season I	Season II	Season I	Season II			Season I	Season II	Season I	Season II
T1	1.74±0.06	5.33±0.06	0.77±0.01	2.14±0.01	1.50±0.09	131.13±4.77	105.11±7.04	290.00±2.87	43.62±3.29	121.80±1.20
T2	1.00±0.06	3.82±0.08	0.47±0.01	1.54±0.01	3.55±0.86	114.04±2.48	161.66±1.91	321.90±3.74	70.38±1.04	143.02±42.47
T3	2.57±0.06	4.62±0.14	1.10±0.01	1.86±0.01	1.44±0.29	120.92±2.19	167.65±2.89	298.71±10.2	56.87±1.23	117.58±4.54
T4	3.46±0.06	7.33±0.05	1.46±0.01	2.95±0.01	4.61±0.20	157.10±1.23	174.33±6.55	380.15±2.61	75.92±2.54	152.06±1.04
T5	3.02±0.05	6.62±0.12	1.28±0.01	2.66±0.01	4.50±0.09	149.80±1.85	152.56±3.92	298.20±5.59	67.85±2.09	118.08±2.21
T6	3.43±0.06	6.59±0.09	1.44±0.01	2.65±0.01	3.33±0.33	158.60±1.79	337.63±9.40	775.93±13.2	193.01±0.56	351.57±1.78
T7	8.59±0.07	13.38±0.07	3.51±0.01	5.36±0.01	1.44±0.29	136.97±6.54	436.70±3.24	718.91±18.8	190.25±1.80	318.48±8.34
T8	6.54±0.28	14.28±0.11	2.69±0.01	5.72±0.01	1.77±0.22	122.37±5.11	177.98±1.81	346.85±4.07	147.78±4.37	326.66±5.57
T9	3.99±0.07	9.25±0.03	1.67±0.01	3.71±0.01	2.38±0.20	125.67±4.67	214.85±9.42	516.55±1.56	96.95±4.08	226.24±0.68
T10	9.58±0.04	14.79±0.11	3.90±0.01	5.93±0.01	2.27±0.43	139.98±2.20	456.10±7.03	765.55±5.19	197.19±3.43	336.07±2.27
T11	4.58±0.13	9.15±0.04	1.90±0.01	3.67±0.01	1.38±0.20	124.80±6.11	236.40±8.50	511.75±1.87	102.48±3.19	225.68±0.82
T12	2.70±0.10	8.19±0.02	1.15±0.01	3.29±0.01	1.33±0.19	133.83±5.98	205.31±6.07	468.70±1.22	109.21±2.66	205.29±0.53
CD	0.31	0.26	0.02	0.01	1.04	12.33	17.49	23.05	7.91	38.26
SE(m)	0.10	0.09	0.01	0.01	0.35	4.17	5.92	7.80	2.68	12.96
SE(d)	0.15	0.12	0.04	0.03	0.50	5.90	8.38	11.04	3.79	18.33
CV	4.33	1.80	0.03	0.05	24.98	5.37	4.50	2.86	4.67	11.24

CD value is calculated at 5% level of significance

T2-Recommended dosage of FYM+NPK, T3-75% Recommended Dosage+ 25% Vermicompost, T4-Recommended Dosage+ 50% Vermicompost, T5-25% Recommended Dosage+ 75% Vermicompost, T6-Vermicompost (100%), T7-Farm Yard Manure (100%), T8-Litter Compost (100%), T9-Vermicompost + Farm Yard Manure (50+50%), T10-Vermicompost + Litter Compost (50+50%), T11-Farm Yard Manure + Litter Compost (50+50%), T-12Vermicompost + Farm Yard Manure + Litter Compost (1/3 each)

The leaf characteristics *i.e.* fresh leaf weight and leaf width and leaf area were found increasing in the plants treated with farm yard manure in combination with vermicompost the

findings were similar to the results of Cabanillas *et al.,* (2013) in basil. Similarly the farm yard manure and poultry manure significantly increases the leaf area, leaf weight, leaf root ratio and yield in *Mentha* (Costa *et al.,* 2013). Increase in growth attribute by vermicompost might be due to the fact that vermicompost has retained the nutrient in soil for the longer period of time and presence of growth hormones in vermicompost influences the endogenous hormonal functions of the plant and it also influences the soil properties positively which increases the aeration, nutrient absorption and water uptake thus increasing the plant biomass and growth (Ayyobi *et al.,* 2014, Verma *et al.,* 2018). Similar findings for the effect of vermicompost on nutrient availability and absorption were reposted by Vali *et al.,* (2020) while working on different organic manure and biofertilizers in sena (*Cassia angustifolia* L.). In present study it was observed that the replacement of 75% to 80% dosages of fertilizer by Vermicompost and combination of vermicompost with farm yard manure shows growth and yield at par with the 100% recommended dosage of NPK fertilizers (Fathi and Najafian, 2020). Similar results by replacing recommended dosage of mineral fertilizers by organic manure (*i.e.* poultry manure) were observed by Pramod *et al.,* (2020). Sharma *et al.,* (2020) reported that replacing 25% of nutrient dosage using vermicompost and poultry manure increases the nutrient uptake and yield of bell pepper plants. Under organic cultivation *Salvia officinalis* shows significant increase in the growth and yield parameters in comparisons to control (without any supplement).

Conclusion

Medicinal and aromatic plants are valuable natural resources having great potential for the improvement of the economy and the health worldwide. Extensive use of chemical fertilizers has leads to the degradation of soil health. From earlier studies it was also reported that extensive use of mineral fertilizers has negative impact on the soil and plant health which makes it adequate for the cultivation of plants. According to the GAPs for medicinal and aromatic plants the use of mineral fertilizers should be minimized and the emphases should be on total organic cultivation. In present investigation it was reported that organic manures and organic seed priming methods had performed better. Organic seed priming with bijamrita showed improvement in the seed germination parameters. The use of organic manure had improves the growth, yield and quality parameters in digitalis. From the findings of current investigation organic manure are suitable for the replacement of mineral fertilizers. They not only enhance the growth, yield and quality of plants but also show positive effect on spoil health without any residual effect unlike mineral fertilizers.

Author's Contribution and Competing Interests

Conducted research as a part of doctoral research and there are no competing interests.

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