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EFFECT OF ORGANIC MANURE IN GROWTH AND YIELD ATTRIBUTING TRAITS OF *BETA VULGARIS* VAR. *BENGALENSIS* HORT. UNDER FOOT HILLS OF HIMALAYAN PLAINS

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ABSTRACT

The current study entitled "Effect of organic manure in growth and yield attributing traits of *Beta vulgaris* var. *bengalensis* Hort. under foot hills of Himalayan plains" was conducted as Experimental Farm, Department of Horticulture, Assam Agriculture University, Jorhat during 2019-20 and 2020-21. The application of organic manure five days of before sowing as a treatment [T_0-T_9] in randomised block design with nine treatment and three replications. The growth and yield traits c.v. All Green significantly influenced by organic inputs. The results revealed that the maximum plant height (35.90 cm), numbers of leaves per plant (21.43), leaf area (292.91 cm^2), whole plant weight (51.26g) and yield (2.97kg/m^2) observed highest in T_8 (RDF). However, a similar trend was followed by T_7 (Enriched compost @ 3t/ha) in which leaf blade petiole ratio was obtained the best. Thus, result concluded that organic inputs i.e, Enriched compost @ 3t/ha can be used as substitute for RDF.

Key words : *Beta vulgaris* var. *bengalensis*, Organic inputs, RDF, Enriched compost.

Introduction

Beta vulgaris var. *bengalensis*, member of Chenopodiaceae family, among the leafy vegetable, it is most commonly consumed leafy vegetable in our country. It is also known as Indian Spinach, Palak, Beet leaf and Spinach Beet. The leaves of the plant are first known to be used in Bengal and thus known as var. *bengalensis*. In context of nutritive value, the vitamin A (97701 IU) 268.60mg nitrogen, 49.68mg phosphorus, 141.68mg potash, 368.00mg calcium, 42.32mg iron, 50.24mg ascorbic acid and 52.00µg carotene content per 100g of edible portion (Choudhury and Rajendran, 1981). It is also a good source of natural antioxidants such as vitamins, flavonoids, folic acid and polyphenols. Since they are rich in minerals, the Palak plant is called "Mines of Minerals" (Thamburaj and Singh, 2015). Leafy vegetables are high nutritious and play a vital role in the daily diet of humans. According to ICMR recommendation for balance diet, recommended dietary allowance (RDA), for leafy vegetables is around 125g/ day. Palak, as a nitrogen-heavy feeder, reacts well to nutrient application. The nitrogen component is a necessary nutrient for the plant's vegetative growth, *i.e.*; a sufficient amount of nitrogen results in a higher green leaf output. Farmers employed a lot of heavy chemical fertilizers and pesticides on their vegetable crops, to increase productivity and profit. As a result, continued use of chemical fertilizers has a negative impact on environmental and ecological, as well as consumer health issues. Considering the adverse effect created due to the use of chemical fertilizer, organic farming is the best alternative to save us from these harmful effects. Organic farming is a method of production that avoids or significantly reduces the use of synthetic fertilizers, pesticides, growth regulators and livestock feed additives (Meena *et al.*, 2020). Organic farming approaches based on naturally

occurring biological processes are combined with scientific knowledge of ecology and modern technology with traditional farming in systems. Organics are essential for re-establishing soil fertility and maintaining agricultural productivity. The organic manure applied to soil provides possible benefits such as improved soil structure, fertility, water holding capacity, increased soil organic matter, and microbial activity that aids in the breakdown of inorganic substances in the soil. Thus, increasing the quality, production of crops, soil as well as human health. Keeping this in mind, the current experiment was designed to determine the best combination of organic manures for the production of *Beta vulgaris* var. *bengalensis.*

Materials and Methods

An investigation on entitled "Effect of organic manure in growth and yield attributing traits of *Beta vulgaris* var. *bengalensis* Hort. under foot hills of Himalayan plains" was conducted as Experimental Farm, Department of Horticulture, Assam Agriculture University, Jorhat during 2019-20 and 2020-21. The field experiment was conducted in Randomized Block Design with nine treatments and three replications. The treatments consist of T_0 (Absolute Control), T_1 (Rockphosphate + Microbial Consortium), T_2 (T_1 + Compost @ 2.5t ha^{-1}), T_3 (T_1+ Compost @ 5t ha^{-1}), T_4 (T_1 + Vermicompost @ 2t ha^{-1}), T_5 (T_1+ Vermicompost @ 4t ha^{-1}), T_6 (Enriched compost @ 1.5t ha^{-1}), T_7 (Enriched compost @ 3t ha^{-1}) and T_8 (FYM @ 20t ha^{-1} + NPK @ 80:60:0 kg ha^{-1}), which is recommended dose of fertilizers (RDF). The treatments were applied in the bed 5 days before sowing. Variety chosen for experiment was All Green. The seeds were soaked overnight before sowing. The next day, healthy and viable seeds were treated with a slurry of biofertilizer consortium and were sown in line by maintaining the inter-row spacing of 20cm. After 50 days of planting, the plants were harvested. The plant height expressed in (cm), weight of leaf blade (g), leaf petiole (g) and leaf blade petiole ratio were calculated by dividing leaf blade by leaf petiole, the numbers of leaves per plant, leaf area (cm^2), whole plant weight (g) and yield per square meter (kg).

Results and Discussion

Plant height

The data presented in Table 1 revealed that all the treatment were significant over control. The maximum plant height of 31.73cm was recorded in T_8 followed by 27.26cm in T_7. In 2020-21, the highest plant height of 42.83cm was recorded in T_7 followed by 40.06cm in T_8. Overall, pooled data analysis revealed that the highest plant height of 35.90 cm was obtained in T_8 at par with T_7 (35.05cm) while the minimum of 14.86cm was observed in T_0 (Control). The higher nutrient availability in inorganic fertilizers during growth promotes better root development and branching, facilitating efficient nutrient uptake. Similar findings were reported by Bindiya (2011) in gherkin, Barik (2017) in ridge gourd. Additionally, organic manures improve soil aeration, enhancing nitrogen absorption from the soil (Das *et al*., 2018). Incorporating organic compost into the soil significantly boosted plant growth, as shown in Table 1.

Weight of leaf blade, leaf petiole and leaf blade petiole ratio

The data presented in Table 1 depicts the weight of leaf blade, leaf petiole and leaf blade petiole ratio. Pooled data revealed that the highest weight of leaf blade per plant was recorded in T_7 (31.39g) and the weight of leaf petiole per plant was recorded in T_8 (11.16g). Therefore, the leaf blade petiole ratio was seen the highest in T_7 (3.01) as it was determined by dividing leaf blade to leaf petiole. This may be attributed to the rich content of macro- and micronutrients, vitamins, and growth hormones present in the soil, which promote better root development and branching. This, in turn, enhances the plant's ability to absorb nutrients. Organic inputs directly influence plant growth by supplying plant growth-regulating substances (PGR), which further facilitate nutrient uptake. A similar finding was reported by Sharma and Agarwal (2014) and Jabeen *et al.* (2017) in spinach beet.

Numbers of leaves at the time of harvest

The data presented in Table 2 revealed that the highest number of leaves was observed in first year T_8 19.86 which was followed by T_7 16.06. The second-year highest number of leaves was observed in T_7 26.70 followed by T_8 23.00. The pooled data over two years revealed that the number of leaves was significantly the highest in treatment T_8 of 21.43 leaves per plant which was at par with T_7 (21.38). The lowest of 7.43 was recorded for T_0 which was observed at par with T_1 (7.63). The superior performance observed in T_8, an inorganic treatment, can be attributed to the higher nutrient availability from synthetic fertilizers during the growth phase. These fertilizers provide a quick release of essential nutrients. The rapid supply of nitrogen, crucial for vegetative growth, promotes greater leaf production and improves nutrient uptake, leading to better plant performance (Islam *et al*., 2011; Hossain *et al*., 2014; Das *et al*., 2018). In contrast, organic manures release nutrients more slowly, which may result in less efficient nutrient uptake and lower leaf production. However, organic manure plays a critical role in improving soil structure by enhancing aggregation, aeration, and water-holding capacity. It also supports root system development by facilitating nutrient flow, promoting

root respiration, nutrient absorption and the growth of both root and aerial parts (Vethamoni and Thampi, 2018).

Leaf area (cm^2) at the time of harvest

Data represented in Table 2 showed that the highest leaf area of 236.36 cm^2 recorded in the treatment T_8 in the first year. In the second year, T_7 was recorded the highest of 362.26cm^2. However, pooled over data showed the highest of 292.91cm^2 leaf area was found in T_8 treatment. The lowest was recorded for T_0 (70.65cm^2, 81.30cm^2 and 75.97cm^2) in 2019-20, 2020-21 and pooled over two years, respectively. The highest in T_8 may be linked directly to readily available nutrients from chemical fertilisers, as well as faster absorption and translocation by plants, resulting in higher photosynthetic activity than other treatments. Specifically, nitrogen, the protein's main ingredient, is required for protoplasm production, which leads to cell division and expansion. Similar results were reported by Bharad *et al*. (2013), Barik (2017) for ridge gourd and Hashimi *et al.* (2019) for palak

Whole Plant weight (g)

The whole plant weight is represented in Table 2. The result shows that the maximum whole plant weight during 1st year was in T_8 (36.93g) and 2nd year was in T_7 (74.13g). The whole plant weight of pooled over two years data revealed that observed T_8 was highest (51.26g) which was at par with T_7 (50.76g) and the lowest was recorded in T_0 of (10.16g). This could be due to more plant height with more numbers of leaves and maximum leaf area, thus there is an overall increase in vegetative growth of the plant in the inorganic treatment *i.e.*, T_8

Table 1 : Effect of manures on plant height (cm), weight of leaf blade (g), weight of leaf petiole (g) and leaf blade petiole ratio.

Treatments	Plant height (cm)			Weight of leaf blade (g)			Weight of leaf petiole (g)			Leaf blade petiole ratio		
	2019-	2020-20	Pooled 21	2019-	2020-20	Pooled 21	2019-	2020-20	Pooled 21	2019-20	2020-21	Pooled
T_0	13.83	15.88	14.86	3.45	5.91	4.68	2.03	2.99	2.51	1.70	1.97	1.83
T_1	18.04	20.66	19.35	5.90	8.06	6.98	2.62	3.23	2.93	2.25	2.47	2.36
T_2	19.00	22.83	20.91	6.09	11.29	8.69	2.64	4.53	3.58	2.31	2.49	2.40
T_3	21.04	24.66	22.85	6.35	16.07	11.21	2.70	6.17	4.44	2.35	2.60	2.47
T_4	23.00	28.70	25.85	6.62	26.99	16.81	2.97	10.00	6.48	2.23	2.69	2.46
T_5	24.39	34.03	29.21	10.91	34.11	22.51	4.32	11.22	7.77	2.53	3.03	2.78
T_6	24.94	37.80	31.37	8.98	31.49	20.23	3.68	11.47	7.58	2.43	2.74	2.58
T_7	27.26	42.83	35.05	17.17	45.61	31.39	6.49	13.46	9.98	2.65	3.38	3.01
T_8	31.73	40.06	35.90	18.97	36.36	27.67	8.04	14.28	11.16	2.35	2.54	2.45
S.Ed(±)	0.61	0.82	0.54	0.04	0.05	0.04	0.04	0.10	0.06	0.01	0.03	0.02
C D (5%)	1.30	1.76	1.10	0.09	0.12	0.08	0.07	0.22	0.11	0.03	0.06	0.03

Table 2 : Effect of manures on number of leaves per plants, leaf area (cm^2), fresh weight of whole plant (g) and yield per meter square (kg).

Treatments	Number of leaves per plants			Leaf Area ($cm^{2)}$			Fresh Weight of whole Plant (g)			Yield per meter square (kg)		
	2019-	2020-20	Pooled 21	2019-	2020-20	Pooled 21	2019-	2020-20	Pooled 21	2019-20	2020-21	Pooled
T_0	7.20	7.66	7.43	70.65	81.30	75.97	7.40	12.93	10.16	0.72	0.71	0.72
T_1	7.33	7.93	7.63	89.23	107.08	98.15	10.40	15.26	12.83	0.93	0.94	0.93
T_2	8.90	9.60	9.25	112.86	125.80	119.33	11.13	20.86	16.00	0.93	1.00	0.96
T_3	9.13	11.13	10.13	134.10	143.31	138.70	11.53	24.33	17.93	1.01	1.13	1.07
T_4	9.46	13.66	11.56	146.00	238.65	192.32	12.63	47.13	29.88	1.05	2.20	1.62
T_5	10.40	17.96	14.18	187.75	336.95	262.35	19.20	55.60	37.40	1.56	2.53	2.05
T_6	10.30	18.13	14.21	173.77	318.30	246.04	16.66	53.00	34.83	1.45	2.45	1.95
T_7	16.06	26.70	21.38	199.93	362.26	281.10	27.40	74.13	50.76	2.58	3.30	2.94
T_8	19.86	23.00	21.43	236.36	349.46	292.91	36.93	65.60	51.26	3.26	2.68	2.97
S.Ed (±)	0.37	0.91	0.52	2.50	8.73	4.66	0.52	0.88	0.53	0.07	0.08	0.05
CD(5%)	0.78	1.92	1.07	5.35	18.68	9.50	1.10	1.86	1.08	0.15	0.16	0.10

(RDF). The similar finding reported by Saikia (2015) in French beans. The results also indicate that the application of different levels of organic fertilizers significantly influenced the whole plant weight (Umar *et al*., 2019).

Yield per square meter (kg)

The data represented in Table 2 of yield per meter square of two years and pooled over two years. In 2019-20, the maximum yield was obtained from T_8 (3.26kg) followed by T_7 (2.58kg). During 2020-21, the highest was recorded for T_7 (3.30kg) followed by T_8. The pooled data over two years revealed that the highest yield m^{-2} was observed in T_8 of 2.97 kg and T_7 of 2.94kg was observed to be at par with T_8 and the lowest was for T_0 of 0.72 kg. The highest yield recorded in the inorganic treatment might be due to a higher dose of nutrient added to the soil under, T_8 (RDF). Available nitrogen in soil is crucial for plant metabolites like protein, enzymes, and chlorophyll, promoting vigorous vegetative growth. Adequate nitrogen application enhances vegetative traits such as plant height, leaf number, and leaf area, directly boosting yield. Similar findings were reported by Bharad *et al*. (2010) in spinach, Islam *et al*. (2011) in Radish Stem amaranth-Indian spinach, Hossain *et al*. (2014) in Indian Spinach, Gogoi and Phookan (2017) in knolkhol and Das *et al*. (2018) in Indian Spinach. Organic fertilizers also significantly improved yield over time, aligning with Machado's (2020) findings on organic compost.

Conclusion

This study demonstrated an improvement in all growth parameters of palak in the subsequent year, with organic fertilizer applications showing a positive impact on growth and yield. The highest plant height (35.90 cm), number of leaves (21.43), leaf area (292.91 cm^2), fresh weight of the whole plant (51.26 kg), and petiole weight per plant (11.16 g) were recorded in T_8 [RDF (FYM @ 20 t ha^{-1} + NPK @ 80:60:0 kg ha^{-1})]. Similarly, the organic treatment T_7 (Enriched compost @ 3 t ha^{-1}) produced comparable results to inorganic treatments for these parameters. However, the highest leaf blade weight per plant (31.39 g) and leaf blade-to-petiole ratio (3.01) were observed in T_7 (Enriched compost @ 3 t ha^{-1}). For yield parameters, both T_8 [RDF (FYM @ 20 t ha^{-1} + NPK @ 80:60:0 kg ha^{-1})] and T_7 (Enriched compost @ 3 t ha^{-1}) exhibited similar trends. These findings suggest that T_7 (Enriched compost @ 3 t ha^{-1}) has strong potential as a suitable organic fertilizer, making it a viable recommendation as it enhance the growth and yield of *Beta vulgaris* var. *bengalensis.*

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