



Bio-effectiveness of Sabuj Gold as Organic Manure on Cabbage, Cauliflower and French Bean

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Authors' contributions

This work was carried out in collaboration among all authors. Authors ER, SS and SB designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SS and SB managed the analyses of the study. Authors ER and SS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The present experiment was laid out in randomized block design maintaining three replications during the *Rabi* season of 2017-18 on three major *Rabi* season crops viz., cabbage, cauliflower, and French bean under four treatment viz., Sabuj Gold as principle sole nutrient supplement with recommended organic and inorganic plant protection inputs as well as recommended standard crop-specific inorganic cultivation practice to evaluate the bio-effectiveness of SABUJ GOLD as main organic manure. The result showed that 100% Organic Manure (Sabuj Gold as a primary nutrient supplement) + full organic recommended certified inputs (plant protection measures) had a predominant significant effect on almost all the characters under study, specifically plant height (26.89 cm in cabbage, 45.32 cm in cauliflower and 55.24 cm in French bean), number of primary branches (7.84 in French bean), leaf quantitative parameters, individual head weight in cabbage (1.32 g), curd weight of cauliflower (1.31 g), pod weight (3.37 g) and pod per plant (46.34) in French bean, yield (32.37 t/ha in cabbage, 17.58 t/ha in cauliflower and 8.94 t/ha in French bean), ascorbic acid in cabbage (65.24 mg/100g) and total chlorophyll in cabbage (445.61 mg/100 g). However, 100% Organic Manure (Sabuj Gold as a primary nutrient supplement) + full recommended inorganic supplement (plant protection measures) showed a significant effect on multiple characters such as

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germination percentage (88.52 %) and ascorbic acid (31.62 mg/100 g) in cabbage, total chlorophyll (424.75 mg/ 100 g in cauliflower and 134.95 mg / 100g in French bean). From the above discussion, it could be concluded that Sabuj Gold as a substitute for inorganic plant nutrient along with organic or inorganic plant protection measures could be very effective in enhancement of important yield and quality-related characters of different commercially important vegetables.

Keywords: Sabuj gold; organic manure; cabbage; cauliflower; French bean; growth; yield; quality.

1. INTRODUCTION

Organic farming is a holistic approach of farming to obtain ensured quality agricultural produce with a minimal negative effect on the environment and the best way to maintain soil health. The recent report from the ministry of chemicals and petrochemicals, the government of India revealed that per capita consumption of chemical fertilizers and pesticides in the agricultural sector is much lower than that of global estimates which gives an easy opportunity to divert the focus more on organic-based crop husbandry. The green revolution in the post-independence era has shown the path for self-sufficiency in food but, sustaining agricultural production against the finite natural resource base demands has shifted from the "resource degrading" chemical agriculture to a "resource protective" biological or organic agriculture. The pesticides and fertilizers along with the direct effect on soil health and ecosystem, being mixed with rain or irrigated water leaked into the drainage system which goes into the drinking water (rivers, wells, lakes, etc.) lead to health hazards and contamination of the environment and also deteriorate the soil health [1]. The heavy metals present in the fertilizers, pesticides, and sewage sludge leach into groundwater and going to be a devastating problem shortly [2,3]. Organic Farming as, "production systems rely heavily on crop rotations, crop residues, animal manures, legumes, green manures, organic wastes, and mineral-bearing rocks to feed the soil and supply plant nutrients. Insects, weeds, and other pests are managed by mechanical cultivation and cultural, biological, and biorational controls" [4]. Organic manures improve Physico-chemical properties of soil like water holding capacity, availability of nutrients maintains C:N ratio, increases the macro/micronutrient content and crop yields, size, flavor, aroma, and quality [5]. But the organic crop yields are 20% less than inorganic crops and unable to meet up the huge agricultural output demand that highly argued for the enrichment of naturally available organic sources by adopting artificial special techniques. Keeping these limitations in mind, the present

investigation has been undertaken to evaluate the response of different important vegetable crops with Sabuj Gold.

2. MATERIALS AND METHODS

The experiment was conducted at Horticulture Instructional Farm, Uttar Banga Krishi Viswavidyalaya (UBKV), Pundibari, Coochbehar during the *Rabi* season in a Randomized Block Design (RBD) to evaluate the bio-effectiveness of SABUJ GOLD as organic manure on Cabbage, Cauliflower, and French bean. Varieties used for the present experiment were Green Express (Sakata) in cabbage, Girija (Seminis) in cauliflower, Falguni (Seminis) in French bean, and collected from the local market. All the treatments under experiment were laid out in a Randomized Block Design maintaining three replications in each treatment with the spacing of 60cm x 60cm having each plot sized of 6m x 6m separately for each crop. All crops under the experiment laid out under four treatments viz., Treatment 1: 100% Organic Manure (Sabuj Gold as a primary nutrient supplement) + full organic recommended certified inputs (plant protection measures), Treatment 2: 100% Organic Manure (Sabuj Gold as a primary nutrient supplement) + full recommended inorganic supplement (plant protection measures), Treatment 3: 100% Inorganic crop-specific standard package of practice and Treatment 4: Nil organic or inorganic supplements in each treatment. The physico-chemical property recorded at the experimental site was 65.71 % sand, 18.1% silt, 14.81 % clay, soil pH 5.55, organic carbon content 0.93 %, available nitrogen content 132.57 kg per hectare, available phosphorus content 43.57 kg per hectare, and available nitrogen content 132.57 kg per hectare.

Sabuj Gold is a dark brown colour processed complex organic manure with neutral pH level, high macro/micronutrient value, and organic acids (approximately contain 5.4 % N, 1.8 % P₂O₅, and 2.6 % K₂O), applied at the rate of 300 kg per acre of land 20 days before sowing and

planting by mixing thoroughly in the soil. Whereas, for 100% In-organic practice 500 g of 10:20:20 NPK complex fertilizer, well mixed thoroughly in each bed. Organic manures such as FYM, vermicompost, and poultry manure applied at 25, 6, and 7 tons per hectare before 20 days before planting. For raising crop all the standard packages of practice were followed for cultural operations as well as plant protection measures. For recording, the observations five well-ripened fruits and/or leaf samples from five healthy plants were selected randomly. The observations recorded on growth and yield parameters like Days to germination, Germination percentage (emergence) (%), Seedling height (cm), Plant height (cm), Number of the folded leaf, Number of an unfolded leaf, Leaf length (cm), Leaf width (cm), Head initiation (days), Head circumference (cm), Curd initiation (days), Head diameter (cm), Pod length (cm), Pod width (mm) and Pod diameter (mm), Pod per plant (French bean), Yield per ha (t/ha). Qualitative observations were recorded on Chlorophyll A, B, and total chlorophyll of leaf and Ascorbic acid content in ripe fruit [6]; β -carotene of ripe fruits [7]; total soluble solids in ripe fruits [8] in milligrams per 100 grams of the sample through the spectrophotometric method. Mean data were processed following Duncan's multiple range test by using SPSS program version 17 to compare the mean values among the treatment.

3. RESULTS AND DISCUSSION

3.1 Cabbage

Data represented in Table 1 showed a significant difference for all the treatments under experiment with respect to germination as a time to emerge as well as the rate of emergence. The minimum number of days taken for germination (9.21 days) and the highest germination percentage (88.52%) were observed in treatment 2 compared to other treatments. Treatment 1 showed significant and highest values for almost all the characters viz., plant height (26.89 cm), number of folded leaves (5.17), number of unfolded leaves (8.89), leaf length (29.58 cm), leaf width (26.65 cm), head circumference (49.12 cm), head diameter (14.31 cm), individual head weight (1.32 g), yield (32.37 tons/ha.), chlorophyll A (321.25mg/100g), chlorophyll B (124.36 mg/100g), total chlorophyll (445.61 mg/100g) of leaf along with early head initiation (48.24 days after transplanting) and head harvest (60.89 days after transplanting) followed by treatment 3; these attributes were recorded least in treatment

4. Whereas, relatively late head initiation (53.34 days after transplanting) and head harvest (66.84 days after transplanting) were noticed in the treatment without adding any organic/inorganic nutrient supplement. There was no significant difference recorded among all the treatments under the experiment for beta carotene. However, treatment 1 exhibited maximum values for beta carotene (0.43 mg/100g) compare to other treatments. But in the case of ascorbic acid content, just the opposite result was recorded and shown a significant difference as treatment 2 showed the highest value (31.62 mg/100g) followed by treatment 2 (31.43 mg/100g) and recorded to be far better than the rest two treatment combinations.

3.2 Cauliflower

Table 2 showed that the number of days to germinate seed was significantly lowest in treatment 1 (7.24 days) followed by treatment 2 (7.45 days). A significant effect of SABUJ GOLD as organic manure was observed on germination percentage and plant height in treatment 1 (84.89% and 45.32 cm, respectively) followed by treatment 2 (i.e., 84.24% and 44.59 cm, respectively). The lowest germination percentage and plant height were obtained in treatment number 4 i.e., 80.21%, and 39.24 cm, respectively. The number of leaves was recorded significantly highest in treatment 2 (16.33) followed by treatment 1 (16.24). There was a direct positive effect of organic treatment on leaf size based on leaf length and leaf width. Treatment 1 showed the highest significant leaf length (36.95 cm) and leaf width (19.07 cm) followed by treatment 2 (35.44 cm leaf 19.05 cm length and leaf width, respectively).

Earliness with respect to curd initiation and harvest time is a very important trait, specifically due to the global warming effect optimal favorable crop growing period is drastically reducing. It was observed that curd was initiated 50.24 days after transplanting and reached to harvesting stage within 61.34 days after transplanting in case of treatment 1 followed by treatment 2 (i.e., 51.37 and 64.87 days after transplanting, respectively). Whereas, significantly delayed production was recorded in treatment 4. Curd yield based on curd diameter, curd weight, and yield per hectare was significantly highest in treatment 1 (i.e., 27.23cm, 1.31 kg, and 17.58 t/ha, respectively) followed by the treatment 2 (i.e., 26.54cm, 1.27 kg, and 17.44 t/ha, respectively).

Table 1. Different quantitative and qualitative characters of Cabbage with the effects of the treatments

T	DG	GP	PH	NFL	NUFL	LL	LW	DHI	DHH	HC	HD	HW	Y	AA	β C	CA	CB	TC
1	9.33	87.44	26.89	5.17	8.89	29.58	26.65	48.24	60.89	49.12	14.31	1.32	32.37	31.43	0.43	321.25	124.36	445.61
2	9.21	88.52	25.84	5.09	8.54	29.55	26.16	48.65	62.15	48.88	14.02	1.29	31.64	31.62	0.41	317.25	121.35	438.67
3	10.42	86.56	25.36	5.01	8.41	28.97	25.44	51.39	64.89	46.94	13.56	1.21	29.67	28.31	0.36	301.54	111.64	413.18
4	11.32	85.69	23.12	4.65	7.11	25.32	22.39	53.34	66.84	42.36	11.87	0.94	23.05	22.54	0.32	289.11	102.43	391.54
SEm ±	0.007	0.04	0.13	0.02	0.05	0.004	0.09	0.08	0.23	0.05	0.05	0.006	0.14	0.04	0.007	0.76	0.55	1.62
CD _{0.05}	0.020	0.15	0.43	0.05	0.18	0.014	0.31	0.26	0.80	0.16	0.17	0.021	0.48	0.14	0.024	2.63	1.90	5.61
CD _{0.01}	0.036	0.23	0.65	0.08	0.28	0.021	0.47	0.40	1.21	0.24	0.26	0.031	0.73	0.21	0.037	3.98	2.88	8.49

Table 2. Different quantitative and qualitative characters of Cauliflower with the effects of the treatments

T	DG	GP	PH	NL	LL	LW	DCI	DCH	CD	CW	Y	AA	β C	CA	CB	TC
1	7.45	84.89	45.32	16.24	36.95	19.07	50.24	61.34	27.23	1.31	17.58	65.24	0.19	321.54	97.86	419.4
2	7.24	84.24	44.59	16.33	35.44	19.05	51.37	64.87	26.54	1.27	17.44	64.25	0.18	326.39	98.36	424.75
3	8.11	83.69	43.97	16.02	32.95	17.65	54.35	68.33	25.37	1.26	17.25	60.33	0.16	316.87	95.44	412.31
4	8.24	80.21	39.24	14.36	30.44	15.32	55.27	71.25	22.15	0.945	12.68	51.98	0.11	284.59	85.61	370.2
SEm ±	0.024	0.12	0.12	0.017	0.31	0.37	0.18	0.51	0.13	0.007	0.027	0.19	0.006	0.91	0.09	1.07
CD _{0.05}	0.083	0.43	0.40	0.059	1.07	1.28	0.62	1.75	0.46	0.026	0.092	0.65	0.020	3.15	0.33	3.71
CD _{0.01}	0.126	0.64	0.61	0.089	1.63	1.94	0.93	2.65	0.70	0.039	0.140	0.98	0.030	4.78	0.50	5.62

Table 3. Different quantitative and qualitative characters of French bean with the effects of the treatment

T	DG	GP	PH	DFF	NPB	PL	PD	PW	NPP	YP	Y	CA(MP)	CB(MP)	TC(MP)	CA(ML)	CB(ML)	TC(ML)
1	11.57	72.22	55.24	41.25	7.84	14.71	2.71	3.37	46.34	151.24	8.94	214.58	96.41	310.99	98.45	27.77	126.22
2	11.41	72.25	52.36	41.01	7.44	14.25	2.65	3.34	42.21	144.68	8.07	201.98	113.23	315.21	101.21	33.74	134.95
3	12.87	71.91	46.87	43.51	6.34	13.95	2.01	2.65	37.88	121.58	6.01	197.42	84.61	282.03	93.54	20.53	114.07
4	14.03	70.08	42.29	45.69	5.44	12.88	1.84	2.01	32.17	88.27	5.34	186.44	83.76	270.2	91.22	25.73	116.95
SEm ±	0.03	0.06	0.56	0.05	0.08	0.09	0.02	0.006	0.82	1.24	0.17	0.86	0.16	0.80	0.44	0.39	0.54
CD _{0.05}	0.11	0.22	1.93	0.16	0.28	0.31	0.05	0.02	2.85	4.28	0.57	2.97	0.56	2.78	1.54	1.35	1.87
CD _{0.01}	0.16	0.34	2.92	0.24	0.42	0.46	0.08	0.03	4.32	6.48	0.87	4.50	0.85	4.21	2.33	2.04	2.83

Note: T- Treatment, DG- Days to germination, GP- Germination percentage, PH- Plant Height (cm), NFL- Number of folded leaves, NUFL-Number of unfolded leaves, LL- Leaf length (cm), LW- Leaf width (cm), DHI- Days to Head initiation, DHH- Days to Head harvest, HC- Head circumference (cm), HD- Head diameter (cm), HW- Head weight (g), Y- Yield (t/ha), AA- Ascorbic acid (mg/100g), β C- β carotene (mg/100g), CA- Chlorophyll-A, CB- Chlorophyll-B, TC- Total Chlorophyll, NL- Number of leaves, DCI- Days to curd initiation, DCH-Days to curd harvest, CD- Curd diameter (cm), CW- Curd weight (g), DFF- Days to first flowering, NPB- Number of Primary Branches, PL- Pod length, PD- Pod diameter (cm), PW-Pod weight (g), NPP- Number of Pods per plant, YP-Yield per plant (g), CA- Chlorophyll-A (Mature pod), CB- Chlorophyll-B (Mature pod), TC- Total Chlorophyll (Mature pod), CA- Chlorophyll-A (Mature Leaf), CB- Chlorophyll-B (Mature Leaf), TC- Total Chlorophyll (Mature Leaf)

The leaf chlorophyll content was highest in treatment 2 *i.e.*, chlorophyll A (326.39 mg/100g), Chlorophyll B (98.36 mg/100g) and total chlorophyll (424.75 mg/100g) followed by treatment 1 (*i.e.*, 321.54 mg/100g, 97.86 mg/100g and 419.40 mg/100g). Ascorbic acid content was found to be maximum in treatment 1 (65.24 mg/100g) followed by treatment 2 (*i.e.*, 64.25 mg/100g). Whereas, the significant lowest ascorbic acid content recorded was 51.98 mg/100g in treatment 4. Regarding beta-carotene, the experiment could not show a clear relationship. Rather all the treatments supplemented by organic and/or inorganic inputs exhibited up-regulated biochemical synthesis for beta-carotene than that of the treatment without any organic/inorganic nutrient supplement.

3.3 French Bean

It was observed (Table 3) that treatment 2 (11.41 days) followed by treatment 1 (11.57 days) had a significant effect on reduction in the days required for the seed germination as compared to the other treatments that might be due to the stimulatory effect of the biochemical present in Sabuj Gold. Hence, there was a direct effect of early germination on days required to the first flower and was lowest in Treatment 2 (41.01 days) followed by treatment 1 (41.25 days). However, with respect to the percent of germination, there was no significant difference among the treatments that might be because germination ability is largely governed by genetic factors and environmental influence.

A significant increase in plant height was observed in treatment 1 (55.24 cm) followed by treatment 2 (52.36 cm). Whereas, the lowest value was recorded in treatment 4 (42.29 cm). Increased plant height was considered as a desirable attribute due to having a direct positive effect on pod number and yield. The significant highest number of primary branches, pod length, pod diameter, pod weight, and the number of pod per plant was recorded in treatment 1 (7.84, 14.71 cm, 2.71 cm, 3.37 g, and 46.34, respectively) followed by treatment 2 (*i.e.*, 7.44, 14.25 cm, 2.65 cm, 3.34 g and 42.21, respectively). A predominant effect of sole treatment of Sabuj Gold as organic manure on different yield attributes can be observed in Table 3. A significantly higher yield per plant (151.24 g), per hectare of land (8.94 t/ha) was obtained from treatment 1. Treatment 2 recorded the second-highest value for yield per plant (144.68g) and per hectare (8.07 t/ha). Whereas a

drastic reduction in yield was observed in treatment 3. Most of the qualitative characters such as a leaf, and chlorophyll were also influenced positively with organic treatment, highest significant total chlorophyll content of leaf (315.21 mg/100g) and pod (134.95 mg/100g) were observed in treatment 2 followed by treatment 1 where pigment composition was total chlorophyll content of leaf (310.99 mg/100g) and pod (126.22 mg/100g).

From the above discussion, it was clear that SABUJ GOLD as an organic supplement improved the physical and biological properties of the soil thereby resulting in higher crop production that might be due to better availability of nutrients in an acceptable form to the plant [9, 10,11]. Application of organic fertilizers reported producing larger leaf areas with better enzyme synthesis and pigment production which in turn improve plant growth [12]. It also increased photosynthesis and stomatal activity due to higher chlorophyll and secondary metabolites production *viz.*, proteins, glycosides, tannins, carotenoids, etc. those are directly involved with the improvement of yield and quality [13]. These finding of the positive effect of the organic supplement on crop production conformed with Thakur et al. [14], Sharma et al. [15], Selim et al. [16], Simarmata et al. [17], Nurhidayatia et al. [18], Islam et al. [19], Jesu [20], Ranjit et al. [21], Sarma et al. [22], Farahzety and Aishah [23], Prabhakar et al. [24] and Singh *et al* [25].

4. CONCLUSION

In the present investigation it was observed that 100% Organic Manure (Sabuj Gold as a primary nutrient supplement) + full organic recommended certified inputs (plant protection measures) had a predominant significant effect on almost all the characters under study, specifically plant height (26.89 cm in cabbage, 45.32 cm in cauliflower and 55.24 cm in French bean), number of primary branches (7.84 in French bean), leaf quantitative parameters, individual head weight in cabbage (1.32 g), curd weight of cauliflower (1.31 g), pod weight (3.37 g) and pod per plant (46.34) in French bean, yield (32.37 t/ha in cabbage, 17.58 t/ha in cauliflower and 8.94 t/ha in French bean), ascorbic acid in cabbage (65.24 mg/100g) and total chlorophyll in cabbage (445.61 mg/100 g). However, 100% Organic Manure (Sabuj Gold as a primary nutrient supplement) + full recommended inorganic supplement (plant protection measures) showed a significant effect on multiple characters such as

germination percentage (88.52 %) and ascorbic acid (31.62 mg/100 g) in cabbage, total chlorophyll (424.75 mg/ 100 g in cauliflower and 134.95 mg / 100g in French bean). From the above discussion, it could be concluded that Sabuj Gold as a substitute for inorganic plant nutrient along with organic or inorganic plant protection measures could be very effective in the enhancement of important yield and quality-related characters of different commercially important vegetables.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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