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Effect of Organic, Inorganic and Biofertilizers on Growth, Yield and Quality of Sponge Gourd (*Luffa aegyptiaca*) cv. TMSG-1609

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The present investigation entitled "Effect of organic fertilizers, inorganic fertilizers and biofertilizers on growth, yield and quality of sponge gourd (*Luffa aegyptiaca*)" was carried out at Department of Horticulture, SHUATS, Prayagraj (U.P) during rabi season of 2022 for evaluation of different treatment combination of organic, inorganic fertilizers and biofertilizers on growth, yield and quality of sponge gourd c.v. TMSG (1609). The experiment was laid out in Randomized Block Design (RBD) with combination traits of 9 treatments, and three replication. Studies shows that, among all the treatments T7 was found to be the best out of the 9 treatments in terms of growth, yield and quality with days to germination (11.5 DAS), days to emergence (25.08 DAS), survival percentage (79.67%),vine length (20,40,60 DAS) (115.60 ,271.10, 453.70 cm), appearance of first male (47.75 DAS) and female flower (54.64%) in 50% flowering, days to first harvest (64.80 DAS), no. of fruits per plant (24.81), fruit length (24.81 cm), fruit diameter (6.13), fruit weight (181.71 g), yield per hectare(t) (16.20 t/ha), TSS (Total soluble solids) (4.72 ^{0}brix), ascorbic acid content (10.01 mg), fruit colour (138.6). In terms of economics, gross return, net return and benefit cost ratio was also recorded in T7 (80% RDF + 20% through vermicompost + PSB + azotobacter) with gross return (Rs, 3,20,400) , net return (Rs 2,35,750) along with benefit cost ratio (3.7).

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1. INTRODUCTION

Cucurbits form an important and big group of vegetable crops and sponge gourd (*Luffa cylindrical* Roem Syn. *Luffa aegyptiaca*) is one of the most important members of this group. Sponge gourd has been cultivated for centuries in the Middle East and India, China, Japan and Malaysia [1]. It is a very popular vegetable in the tropical and subtropical regions. It is commonly called as smooth luffa, climbing okra, dishcloth gourd and Chinese okra. It is an important crop rotation during spring summer and rainy season in North Indian condition and is cultivated both on commercial scale and in kitchen gardens (Choudhary, 1966). Sponge gourd is native to Tropical Asia, probably India and South East Asia. The tender fruit is used as vegetable which is easily digestible and increase appetite when consumed [2]. The fibrous vascular system inside the fruit after been separated from the skin, flesh and seeds, can be used as bathroom sponge, as a component of shock absorbers, as a sound proof linings, as a utensils cleaning sponge. As packing materials, for making crafts, as filters in factories and as a part of soles of shoes [3]. This crop has a long history of cultivation in the tropical countries [4].

Nitrogen (N), phosphorus (P) and potassium (K) play a significant role in the plant growth and development such as N supports the vegetative part of the plant and P has a significant role in the development of the root and also producing the energy by forming ATP and K encourages carbohydrates metabolism, enzymes establishment and osmotic regulation [5]. Organic fertilizer application improve the growth of sponge gourd by supplying plant nutrients including micro nutrients as well as improving chemical, physical and biological properties of the soil, thereby providing a better environment for root development by improving the soil structure [6,7]. To achieve higher production of sponge gourd the expensive commercial fertilizers are recommended but use of excess inorganic fertilizers as per the recommendations soil health and environment sustainability is on sake. So to achieve higher productivity and to maintain the environment balance use of chemical fertilizers is needed. Application of organic fertilizer, biofertilizers which is environment friendly and low cost input with inorganic fertilizers play an important role in plant nutrition. The application of biofertilizer is very good for sustainable agriculture [8-10].

2. MATERIALS AND METHODS

The experiment was conducted in Horticultural Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (UP) during 2022. All the facilities necessary for cultivation, including labour were made available by the department. It is situated at an elevation of 98 meters above sea level at $25^0$87 North latitude and 81.15^0 East longitude. The soil properties of the experimental field was sandy loam with average fertility level and pH in the range of 7.0 to 8.0.This region has a sub-tropical climate prevailing in the South-East part of Uttar Pradesh with both the extremes in temperature, i.e. the winter and the summer. The sowing of seed of sponge gourd was done in February 9, 2022 .The experiment was laid out in Randomized Block Design (RBD) with 9 treatments and 3 replications at a spacing of 60 cm x 120 cm. Normal cultural practices and plant protection measures was followed during the cultivation process. Treatments involved were T_0- (90% RDF + FYM 20t/ha), T_1- (80% RDF + 20% through FYM), T_2- (80% RDF + 20% through vermicompost), T_3 (80% RDF + 20% through FYM + PSB), T_4- (80% RDF + 20% through vermicompost + PSB), T_5 (80% RDF + 20% through FYM + Azotobacter), T_6 (80% RDF + 20% through FYM + Azotobacter), T_7- (80% RDF + 20% through FYM + PSB + Azotobacter), T_8- (80% RDF + 20% through FYM + PSB + Azotobacter). The field was prepared well by proper ploughing and tillage. The seeds were soaked overnight treated with the treatments and sown the next day in February 9, 2022 with respective spacing. The observation regarding growth, yield and quality were recorded. The sources of organic and inorganic fertilizers applied in this treatments are FYM and vermicompost, urea, DAP (Di- Ammonium Phosphate) and MOP (Muriate of Potash) and as for biofertilizer PSB and azotobacter. The significance and non- significance of the treatment effect was judged with the help of 'f' value (variance ratio) was compared with the table value at 5% level of significance. The significant difference between the means was tested against critical difference at 5% level of significance.

3. RESULTS AND DISCUSSION

3.1 Growth Parameters

The data on growth parameters in different treatment combinations were recorded in Table 2. In the experiments the results show that The minimum days to germination was recorded in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) at (10.1 DAS) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) at (10.3 DAS) and the maximum days to germination was recorded in T_0 (90% RDF +FYM 20 t/ha) at (11.5 DAS). The minimum days to emergence of true leaf was observed in T_7 (80% CF + 20% through FYM + PSB + Azotobacter) at (22.06 DAS) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) at (23.02 DAS) and the maximum days to emergence of true leaf was observed in T_0 (90% RDF + FYM 20 t/ha) at (25.08 DAS). The highest survival percentage was observed in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) at (79.67%) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) at (78.82%) and the minimum survival percentage was observed in T_0 (RDF (90% RDF + 20 t/ha) at (71.23%). The minimum days to 50% flowering was observed in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) at (38.37 DAS) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) at (40.61 DAS) and the maximum days to 50% flowering was recorded in T_0 (90% RDF +FYM 20 t/ha) at (54.64 DAS). The maximum vine length in 40 days was seen in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (271.10 cm) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) with 242.00 cm) and the minimum vine length in 40 days was seen in T_0 (90% RDF +FYM 20 t/ha) with (203.10 cm). The minimum days to first harvest was recorded in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (64.80 DAS) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) with (65.40 DAS) and the maximum days to harvest was recorded in T_0 (90% RDF +FYM 20 t/ha) with (68.20 DAS). The plant does not need any food or nutrients for few days because there is enough food and all other things stored in the cotyledons which is necessary for seed germination [11]. The Jaipuri cultivar had greater seedlings emergence percentage because of the genetic combination. Some other factors may also be responsible for good emergence percentage which may be seed purity, climatic condition, thin seed coat, good moisture availability and favourable conditions [12]. The balance use of organic fertilizer and inorganic fertilizer has recommended for nutrition and long term cropping. The results are in conformity with the results of (Jose et al., 1998) found that the combine use of poultry manure and urea increase the germination, flowering and other vegetative yield attributes of eggplant. According to Sareedhar et al., [13] the maximum vine length, number of leaves and length of Gherkin was recorded in plots having recommended dose of NPK alongside organic manure. Sureshkumar and Karupaiah [14] reported that maximum vine length of bitter gourd was recorded with the application of NPK and organic manure.

3.2 Yield Parameters

The data on yield parameters in different treatment combinations were recorded in Table 3. In the experiments the results show that The maximum fruit length was seen in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (24.81 cm) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) with (23.92 cm) and the minimum fruit length was seen in T_0 (90% RDF +FYM 20 t/ha) with (10.17 cm). The maximum fruit diameter was seen in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (6.13) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) with (6.07) and the minimum fruit diameter was seen in T_0 (90%

Table 1. Treatment Combination details used in present experiment

Treatment symbols	Treatment Combinations
T_0	(90% RDF + FYM 20t/ha)
T_1	(80% RDF + 20% through FYM)
T_2	(80% RDF + 20% through vermicompost)
T_3	(80% RDF + 20% through FYM + PSB)
T_4	(80% RDF + 20% through vermicompost + PSB)
T_5	(80% RDF + 20% through FYM + Azotobacter)
T_6	(80% RDF + 20% through FYM + Azotobacter)
T_7	(80% RDF + 20% through FYM + PSB + Azotobacter)
T_8	(80% RDF + 20% through FYM + PSB + Azotobacter).

Table 2. Effect of organic fertilizers, inorganic fertilizers and bio fertilizers on growth of sponge gourd c.v. TMSG 1609 recorded

Treatment	Days to germination	Days to emergence	Survival percentage	Days to 50% flowering	Vine length (40 days)	Days to first harvest
T_0	11.5	25.08	71.23	54.64	203.10	68.20
T_1	11.1	24.09	71.66	51.12	215.70	66.60
T_2	11.2	25.06	73.38	50.86	216.30	67.50
T_3	11	25.07	74.89	46.38	218.10	66.60
T_4	10.8	25.06	75.81	45.19	231.00	66.40
T_5	10.6	25	76.94	41.37	234.60	66.10
T_6	10.3	23.02	78.82	40.61	242.00	65.40
T_7	10.1	22.06	79.67	38.37	271.10	64.80
T_8	10.5	23.06	78.39	41.31	238.04	66
S.Ed(±)	0.45	0.73	3.29	1.58	12.61	3.06
CD at 5%	1.83	2.94	9.10	3.36	26.73	6.04

RDF + FYM 20 t/ha) with (4.08). The maximum fruit weight was seen in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (181.71 g) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) with (174.34g) and the minimum fruit weight was seen in T0 (90% RDF + FYM 20 t/ha) with (76.08 g). The maximum no. of fruits was recorded in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (24.81) followed by T_6 (80% RDF through CF + 20% through FYM + Azotobacter) with (23.92) and the minimum no. of fruits was recorded in T_0 (90% + RDF +FYM 20 t/ha) with (10.17). The maximum Yield per hectare was observed in T7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (16.20 t/ha) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) with (15.75 t/ha) and the minimum yield per hectare was recorded in T0 (90% + RDF +FYM 20 t/ha) with (8.34 t/ha). Total yield per vine was found to be positively and significantly correlated with number of fruits per vine, average weight of fruit, number of seeds per fruit. (Kumar et al., 2013). The application of FYM + NPK produced maximum yield of sponge gourd because the inorganic source of nutrients with the addition of organic source such as farmyard manure, poultry manure or vermicompost increased plant growth favourably with the synthesis of more carbohydrates. Under this circumstances, flow of assimilates to sink was maximum and maybe they caused higher fruit length, fruit weight and maximum yield of the crop [15]. Similar findings were noted by [16] in sunflower who reported that organic manure with combination of inorganic fertilizers significantly increase quality and yield of sunflower.

Table 3. Effect of organic fertilizers, inorganic fertilizers and bio fertilizers on yield of sponge gourd c.v. TMSG 1609 recorded

Treatments	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	No. of fruits per plant	Yield per hectare (t/ha)
T_0	10.17	4.08	76.08	10.17	8.34
T_1	11.50	4.29	86.74	11.50	8.62
T_2	13.04	4.36	97.21	13.04	11.53
T_3	13.37	5.07	102.62	13.27	14.08
T_4	16.95	5.16	138.56	16.95	14.48
T_5	17.62	5.21	161.39	17.62	15.57
T_6	23.92	6.07	174.34	23.92	15.75
T_7	24.81	6.13	181.71	24.81	16.20
T_8	18.31	5.62	164.31	18.31	15.69
SEd(±)	0.81	0.2	8.26	0.67	0.23
CD at 5%	1.72	0.42	17.51	1.72	1.56

Table 4. Effect of organic fertilizers, inorganic fertilizers and bio fertilizers on quality of sponge gourd c.v. TMSG 1609 recorded

Treatments	TSS	Ascorbic acid	Fruit colour
T_0	4.26	7.75	132.06
T_1	4.36	7.90	132.6
T_2	4.4	8.12	133.7
T_3	4.53	8.20	133.8
T_4	4.59	8.34	134
T_5	4.63	8.56	134.4
T_6	4.7	9.54	136.5
T_7	4.72	10.01	138.6
T_8	4.65	8.75	135.3
SEd(±)	1.22	0.01	0.34
CD at 5%	0.17	0.88	0.23

3.3 Quality Parameters

The data on quality parameters in different treatment combinations were recorded Table 4. In the experiments the results show that The maximum total soluble solids were recorded in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (4.72^0 brix) followed by T6 (80% RDF + 20% through FYM + Azotobacter) with (4.7^0 brix) and the minimum total soluble solids was recorded in T_0 (90%RDF +FYM 20 t/ha) with (4.26^0 brix).The Vitamin C content was measured by using spectroscophotometric methods. The maximum ascorbic acid content was observed in T_7 (80% RDF through CF + 20% through FYM + PSB + Azotobacter) with (10.01 mg) followed by T_6 (80% RDF through CF + 20% through FYM + Azotobacter) with (9.54 mg) and the minimum ascorbic acid content was observed in T_0 (RDF (90% RDF + FYM 20 t/ha) with (8.34 mg). The maximum fruit colour was observed in T_7 (80% RDF + 20% through FYM + PSB + Azotobacter) with (138.6) followed by T_6 (80% RDF + 20% through FYM + Azotobacter) with (136.5) and the minimum fruit colour was observed in T_0 (90% + RDF +FYM 20 t/ha) with (132.06). The fruit colour was measured with the help of colorimeters.The TSS was maximum for T6 and range between 15.23 to 16.20. T_1 scored lowest for TSS and varied from 15.06 to 15.83 during the course of storage. The increasing trend of TSS in blended bottle gourd beverage was probably due to conversion of soluble carbohydrate (sugars). Similar findings was reported by Verma (2009) in bottle gourd beverages. The ascorbic acid of beverage was determined by the procedure given by Ranganna [17]. The maximum ascorbic acid was in T_6 which was ranged from 8.00 to 5,22. The least ascorbic acid content was T_1 and ranged 3.84 to 1.70 during the course of storage. Significant decrease in ascorbic acid during storage may be due to thermal degradation during processing and subsequent oxidation during storage period as it is highly sensitive to heat, oxidation and light.

4. CONCLUSION

The results from the present investigation concluded Sponge gourd (*Luffa aegyptiaca*) T_7 (80% RDF + 20% through vermicompost + Azotobacter) was identified as the superior treatment in terms of growth, yield and quality of Sponge gourd (*Luffa aegyptiaca*) cv (TMSG 1609). Regarding economics of various treatments maximum gross return (Rs 3,20,400) and net return (Rs.2,35,750) along the benefit cost ratio (3.7) was also obtained maximum in T_7 (80% RDF + 20% through vermicompost + Azotobacter).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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