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STUDIES ON THE EFFECT OF CERTAIN ORGANIC INPUTS IN YIELD MAXIMIZATION AND ANALYSIS OF RHIZOSPHERE MICROFLORA IN OKRA cv. Arka anamika

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Abstract

Indiscriminate use of inorganic fertilizers and pesticides has caused health hazards to human, besides deteriorating the soil, groundwater and environment ecology. Thus, there is need to integrate and balance supply of chemical fertilizers, organic manures and biofertilizers for sustaining productivity and soil health and also supplementing a part of chemical fertilizer requirement through these resources. An investigation was carried out to study the influence of organic inputs in okra at the vegetable field unit of the Department of Horticulture, Faculty of Agriculture, Annamalai University. Okra seeds of cv. Arka Anamika were used in this investigation. The experiment was conducted as a field study in Randomized block design (RBD) with 12 treatments in three replications. The treatments include bulky organic manures, concentrated organic manure, biofertilizer consortium, foliar organic nutrients and chemical fertilizers. The bulky organic manures used were FYM (12.5 and 25 t ha^{-1}) and vermicompost (2.5 and 5 t ha^{-1}). The concentrated organic manure used was neem cake (1 t ha^{-1}). Panchakavya (3 %) and humic acid (0.2 %) were tried as foliar nutrition. Farmyard manure, vermicompost, biofertilizers consortium and neem cake were applied basally. Foliar spray was given three times starting from two weeks after sowing at 15 days interval. Among the various treatments tried, application of farmyard manure @12.5 t ha^{-1} plus vermicompost @ 2.5 t ha^{-1} plus biofertilizers consortium @ 2 kg ha^{-1} plus neem cake @ 1 t ha^{-1} along with humic acid @ 0.2 per cent (foliar spray) resulted in increasing the yield of okra. This was followed by the treatment which received application of farmyard manure @12.5 t ha^{-1} plus vermicompost @ 2.5 t ha^{-1} plus biofertilizers consortium @ 2 kg ha^{-1} plus neem cake @ 1 t ha^{-1} along with panchakavya @ 3 % and the treatment which received application of chemical fertilizers. The microbial population in post harvest soil was maximum with the application of farmyard manure @12.5 t ha^{-1} plus vermicompost @ 2.5 t ha^{-1} plus biofertilizers consortium @ 2 kg ha^{-1} plus neem cake @ 1 t ha^{-1} along with humic acid @ 0.2% (foliar spray).

Key words: Okra, Panchakavya, Humic acid, FYM, Neem cake and Biofertilizer consortium .

1. Introduction

Okra (*Abelmoschus esculentus* L. Moench.) is also known as 'lady's finger' or bhendi. It is a popular vegetable grown under tropical and sub-tropical conditions. It is valued for its tender and delicious fruits mainly in culinary preparations and to a limited extent in canning, dehydration and freezing. It is a nutritious vegetable containing considerable quantities of vitamins and minerals especially iron and fair amount of vitamin-C, besides, secondary metabolites that are believed to have anticancer properties (Mahimairaja, 2006). It is a semi woody, fibrous

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herbaceous annual with an indeterminate growth habit. The plants form a deeply penetrating taproot with dense shallow feeder roots reaching out in all direction in the upper 45 cm of the soil. The area under cultivation of this crop in India is about 5, 32,000 hectares and production is about 63, 46,000 metric tonnes. The maximum area under this crop lies in Uttar Pradash, followed by Orissa, Bihar and West Bengal. In Tamil Nadu, the area under cultivation is 7070 hectares with a production of about 67,140 tonnes and the productivity is about 9.5 t ha^{-1} whereas the national productivity is 10.5 t ha^{-1} (Anon, 2014). Indiscriminate use of chemical fertilizers, pesticides and herbicides has led to the deterioration of soil health, ground water quality, soil microbial population, atmospheric constituents, quality of the agricultural produce and thereby the health of animals and humans. Therefore, to avoid the above-mentioned problems associated with modern agriculture, emphasis is now laid on the use of organic inputs. Okra responds very well for nutrient management. Since, the emphasis is given for quality produces, this study on organic farming in okra is designed to study the influence of organic manures, bio fertilizers in association with foliar nutrition on the yield of okra and soil microbial population of okra field.

2. Materials and Methods

An investigation was carried out to study the influence of organic inputs in okra at the vegetable field unit of the Department of Horticulture, Faculty of Agriculture, Annamalai University. Okra seeds of cv. Arka Anamika were used in this investigation. The experiment was conducted as a field study in Randomized block design (RBD) with 12 treatments in three replications. The treatments include bulky organic manures, concentrated organic manure, biofertilizer consortium, foliar organic nutrients and chemical fertilizers. The bulky organic manures used were FYM (12.5 and 25 t ha^{-1}) and vermicompost (2.5 and 5 t ha^{-1}). The concentrated organic manure used was neem cake (1 t ha^{-1}). Panchakavya (3%) and humic acid (0.2%) were tried as foliar nutrition. Farmyard manure, vermicompost, biofertilizers consortium and neem cake were applied basally. Foliar spray was given three times starting from two weeks after sowing at 15 days interval. Ten gram of soil was taken for making suspension and was cultured with different media following the dilution plate technique as suggested by Allen (1953). The number of fungal colonies developed in Rose Bengal agar, bacterial colonies on soil extract agar, actinomycetes on Kurtur's agar were counted in soil samples twice before sowing and after final harvesting under each treatment.

3. Results and Discussion

The highest yield per plant was obtained in T_{10} (256.23 g in first and 260.28 g in second season) in which the application of FYM (12.5 t ha^{-1}) + VC (2.5 t ha^{-1}) + BFC (2 kg ha^{-1}) + NC (1 t ha^{-1}) + HA @ 0.2% was applied. This was followed by T_9 (238.14 g in first season and 246.38 g in second season respectively), in which FYM (12.5 t ha^{-1}) + VC (2.5 t ha^{-1}) + BFC (2 kg ha^{-1}) + NC (1 t ha^{-1}) + PK @ 3% was applied. The lowest mean value was obtained in absolute control - T_{12} (81.68 g in first season and 82.35 g in second season). The yield ranges from 6.05 to 18.96 t ha^{-1} in the first season and 6.10 t ha^{-1} to 19.28 t ha^{-1} in the second season. The highest yield (18.96 t ha^{-1} in first season and 19.28 t ha^{-1} in second season) was recorded in T_{10}, which received the application FYM (12.5 t ha^{-1}) + VC (2.5 t ha^{-1}) + BFC (2 kg ha^{-1}) + NC (1 t ha^{-1}) + HA @ 0.2%. This was followed by, T_9 (FYM (12.5 t ha^{-1}) + VC (2.5 t ha^{-1}) + BFC (2 kg ha^{-1}) + NC (1 t ha^{-1}) + PK @ 3%) which registered 17.64 t ha^{-1} in first season and 18.25 t ha^{-1} in second season. The minimum was recorded in T_{12} (6.05 t ha^{-1} in first season and 6.10 t ha^{-1} in second season) which served as absolute control. The pooled mean data on yield per hectare shows that the maximum was recorded in T_{10} (19.12 t ha^{-1}), followed by T_9 (17.94 t ha^{-1}) and T_{11} (16.64 t ha^{-1}). The minimum was recorded in T_{12} (6.08 t ha^{-1}). Higher yield might be due to improved aeration and water-holding capacity of FYM applied soil and the efficient utilization of nutrients in the FYM applied plants.

Table – 1: Influence of certain organic inputs on the yield of okra cv. Arka Anamika

Treatments	Yield per plant (g)			Yield per hectare (t)		
	First season	Second season	Pooled	First season	Second season	Pooled
T_1	120.69	124.47	122.58	8.94	9.22	9.08
T_2	136.62	143.78	140.20	10.12	10.65	10.38
T_3	155.66	161.87	158.76	11.53	11.99	11.76
T_4	171.45	177.12	174.28	12.70	13.12	12.91
T_5	185.76	192.38	189.07	13.76	14.25	14.00
T_6	190.89	202.37	196.63	14.14	14.99	14.56
T_7	200.07	207.90	203.98	14.82	15.40	15.11
T_8	214.38	222.48	218.43	15.88	16.48	16.18
T_9	238.14	246.38	242.26	17.64	18.25	17.94
T_{10}	256.23	260.28	258.25	18.96	19.28	19.12
T_{11}	220.86	228.55	224.70	16.36	16.93	16.64
T_{12}	81.68	82.35	82.02	6.05	6.10	6.08
S.Ed.	3.14	2.75	3.12	0.13	0.20	0.22
CD (p = 0.05)	6.28	5.50	6.25	0.25	0.40	0.45

Table – 2: Influence of certain organic inputs on the microbial population of post harvest soil

Treatments	Number of cfu per g of dry soil					
	Season I			Season II		
	Bacteria ($\times 10^{-6}$)	Actinomycetes ($\times 10^{-4}$)	Fungi ($\times 10^{-3}$)	Bacteria ($\times 10^{-6}$)	Actinomycetes ($\times 10^{-4}$)	Fungi ($\times 10^{-3}$)
T_1	13	2	5	16	3	6
T_2	14	2	7	18	3	7
T_3	16	3	8	19	4	9
T_4	17	3	10	20	4	10
T_5	18	4	11	22	5	12
T_6	20	4	12	23	6	14
T_7	21	5	14	24	7	15
T_8	22	6	15	25	7	16
T_9	23	7	16	26	8	17
T_{10}	24	7	17	28	8	19
T_{11}	12	1	4	14	2	5
T_{12}	10	1	3	11	1	4
S.Ed.	-	-	-	-	-	-
CD (p =0.05)	DNSA	DNSA	DNSA	DNSA	DNSA	DNSA

Note: DNSA – Data not statistically analyzed **,** cfu – colony forming units

Organic manures provided sufficient quantity of carbonaceous material for decomposition by microorganisms and converting them into mineralized organic colloids, besides adding them to soil reserves. Increase in yield and yield attributing characters with organic manures was due to increased availability of nutrients for longer period and reduced loss of nutrients through leaching (Sagre and Guhe, 1991).

Further higher yields due to application of vermicompost may be attributed to the high level of nutrients along with growth stimulating substances excreted by earthworms into their casts. Moreover, the increased yield over control could be attributed to the presence of quinine groups in humic acid which act as hydrogen acceptors and serve as activators of oxygen during photosynthesis and stimulate the plant growth resulting in higher yield. This is in agreement with the findings of Stevenson (1986) in cereals.

Further, soil applied FYM and neem cake might have acted as nutrient sources resulting in highest uptake of nutrients by plants. This might have resulted in higher photosynthetic activity and higher accumulation of reserved photosynthates, which might have enhanced the flowering, fruit development and ultimately the yield. The favourable effect of FYM and neem cake on yield attributes have been reported by Akande *et al.* (2006) in bhendi.

Apart from this, *Azospirillum* is known to produce growth promotic compounds such as gibberllins, cytokinin like substances and auxins such as IAA (Tien *et al.,* 1979). These phytohormones like auxin and gibberellins in addition with atmospheric nitrogen fixed by *Azospirillum* might have resulted in enhanced cell elongation and thereby growth and yield as reported by Paramaguru and Natarajan (1993) in chillies. According to Hayman (1975), phosphobacteria solubilize and increase the availability of organic phosphorus to the plants and its uptake by the way of production of organic acids and thereby increasing the growth and yield of the plants. The results are in confirmatory with Velmurugan (2002) in turmeric and Uma Maheswari (2009) in hot pepper. Perusal of the data presented in Table – 2 reveals that the highest population of bacteria (24×10^{-6} and 28×10^{-6} per gram of soil for first and second season respectively), fungi (17×10^{-3} and 19×10^{-3} per gram of soil for first and second season respectively), actinomycetes (7×10^{-4} and 8×10^{-4} per gram of soil for first and second season respectively) was recorded in T_{10} in which FYM (12.5 t ha^{-1}) + VC (2.5 t ha^{-1}) + BFC (2 kg ha^{-1}) + NC (1 t ha^{-1}) + HA @ 0.2 % was applied. This was followed by T_9 (23×10^{-6} and 26×10^{-6} per gram of soil for bacteria, 16×10^{-3} and 17×10^{-3} per gram of soil for fungi and 7×10^{-4} and 8×10^{-4} per gram of soil for actinomtycetes for first and second season respectively) which received the application of FYM (12.5 t ha^{-1}) + VC (2.5 t ha^{-1}) + BFC (2 kg ha^{-1}) + NC (1 t ha^{-1}) + PK @ 3 %. The least value for microbial population (10×10^{-6} and 11×10^{-6} per gram of soil for bacteria; 3×10^{-3} and 4×10^{-3} per gram of soil for fungi and 1×10^{-4} per gram of soil for actinomycetes for first and second season respectively) was recorded in control (T_{12}).

Hayworth *et al.* (1996) opined that FYM, being a bulky organic material releases the soil compaction and improves the aeration in addition to the supply of essential plant nutrients and organic matter, thereby increasing the soil biological activities. Further higher activity of microbes in the soil might be due to the addition of vermicompost, biofertilizers consortium and neem cake. Thus, it can be concluded from the present study, application of FYM (12.5 t ha^{-1}) + VC (2.5 t ha^{-1}) + BFC (2 kg ha^{-1}) + NC (1 t ha^{-1}) along with HA @ 0.2 % foliar spray was found to have beneficial effect on enhancing the yield of okra and soil microbial population of okra field. Therefore, this investigation offers scope for further experimentation on a large scale to confirm and refine this technology for efficient exploitation and to benefit the farmers cultivating okra.

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