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Comparative study on use of organic inputs in Okra [*Abelmoschus esculentus* (L). Moench]

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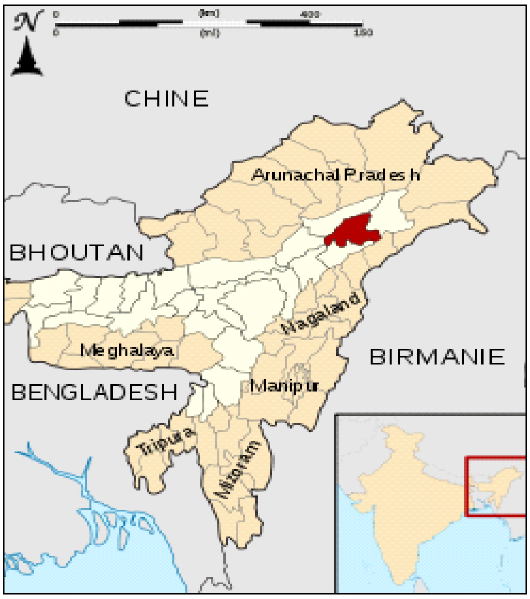
Abstract
A field experiment was conducted in Kutuha village of Borboruah tehsil, Dibrugarh district and Mothiasiga village of Sivasagar district during 2014-2016 on "Comparative study on use of organic inputs in okra" at Dibrugarh and Sivasagar districts of Assam. Combine application of FYM, Biofertilizers and Rock phosphate were used for conducting the experiment. In both the farms difference was observed on plant height (cm), days to first flowering, days to first picking, number of fruits per plant, fruit length (cm), fruit girth (cm), fruit weight per plant (g), shelf life, moisture content (per cent) and benefit cost ratio as compared to farmers practice. It is suggested that instead of using only FYM, combination of FYM, Azotobacter, PSB, Rock phosphate as seed and soil treatment could be possible to reduce the productivity gap and has higher feasibility of the improved technology at the farmers field under existing agro climatic situations.

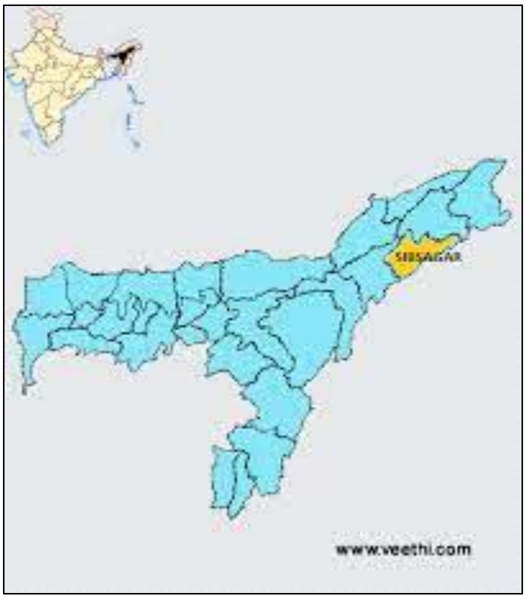
Keywords: Okra, Biofetilizers, rock phosphate, technology index

Introduction
India with diversified agro-climatic zones is suitable to grow a wide variety of vegetable crops. With a production level of 176.2 million metric tonnes of vegetables, India is the second largest vegetable producing country after China, in the world, accounting for 14% of the total world vegetable production (Technical bulletin[a], 2017) [17]. In the year 2015-16 India had exported 6, 99,600.34 MT of fresh vegetables worth Rs. 2119.50 crores (Technical bulletin[b], 2017) [18]. Organic vegetable cultivation offers one of the most sustainable farming systems provides sustainability in production by importing better resistance against various biotic and abiotic stresses. Organic farming is a holistic approach to improve the health of underlying productivity of the soil (Palaniappan and Annadurai, 1999) [9]. Organic harvest of vegetables fetches 10-50% more price over conventional harvests. The produces under organic farming are nutritious, safe and free from chemical residues. On the other hand, chemical based farming has adverse affect on soil as well as animal and human health and eco system. Because of less or no application of fertilizers and chemicals in production process, in comparison to the other progressive states, most of the areas of Assam are considered as organic by default. These areas may be easily converted to organic cultivation for production of different horticultural crops. Okra is an important annual vegetable crop grown in tropical and sub-tropical parts of the world. It is cultivated for its tender green pods, used in soups and curries after cooking. Fruits are also dried or frozen during off -season and the fibres are used in manufacture of paper, card board. It is an excellent source of vitamins A, B, proteins and minerals. Organic farming with the use of biofertilizers and other organic inputs in vegetables is still in its infant stage in Assam. Focusing that the experiment was conducted under KVK's in the farmers field of Sivasagar and Dibrugarh districts of Assam, where the farmers grow okra in conventional method of cultivation with FYM only without following any package due to less technical knowhow and risk factor. Therefore, this experiment was conducted under the supervision of KVK scientists to study and evaluate the performance of organic inputs on certain growth, yield and economic parameters of okra which can be act as lucrative business for rural youths for economic security.

Materials and Methods
Krishi Vigyan Kendra, Dibrugarh situated at 27.40° N latitude and the 95.04° E longitude and Krishi Vigyan Kendra, Sivasagar situated between 26.45°N and 27.15°N latitudes and 94.25°E and 95.25°E longitudes. Kutuha, Borboruah tehsil of Dibrugarh district and Mothiasiga, Nazira tehsil of Sivasagar district where farming is the main source of the livelihood. An experiment was conducted during 2014-16 under KVK Dibrugarh and Sivasagar of Assam to increase the yield and income of the farmers using organic inputs of nutrients over traditional farmers practice.



Dibrugarh district of Assam



Sivasagar district of Assam

In both the villages Kutuha (farm 1) and Mothiasiga (farm 2) three progressive trial of organic technology was conducted covering total of 1.56 ha area of both the farms (1and 2). The okra variety Arka Anamika seeds were treated with 7.5g/100 g seeds with Azotobacter and 7.5g/100g seeds with PSB and allow the seeds to dry in shade. After drying in shade the seeds were sown directly in the well prepared field at spacing of 50 cm X 45 cm. Before sowing FYM @5t/ha + Rock Phosphate@320kg/ha + Azotobacter + PSB were applied in the soil at the time of land preparation as basal application. The treatment was compared with farmers practice in terms of growth, yield and economic parameters. The technologies demonstrated are maintained and compared with farmers practice. The technology gap, extension gap and technological index (Kacha and Patel, 2015) [7] were calculated by using following formula as given below equations.

$$\text{Percentage increased yield} = \frac{\text{Demonstration yield - Local check yield}}{\text{Local Check yield}} \times 100$$

Extension gap = Demonstration yield - farmers practice yield

Technology gap = Potential yield - Demonstration yield

$$\text{Technology index} = \frac{\text{Potential yield- Demonstration yield}}{\text{Potential yield}} \times 100$$

Discussion

Azotobacter inoculants when applied to the crops either as seed treatment or as seedling root dip or soils treatment, large number of Azotobacter cells sticks to the seed or roots and multiply rapidly in the soils along with the developing root and form a thick sheath of bacterial population around roots. For their multiplication the food is derived either form dead organic matter present in the soils or from root exudates excreted by the developing roots. During this process they fix atmospheric nitrogen for their own build- up and eventually released to the close vicinity of roots. Thus released nitrogen is quickly absorbed by the plant (Subba Rao, 1993) [16]. P-solubilizers improved the plant growth and development by the production of plant growth hormones like indole acetic acid (IAA), gibberellic acid (GA) and cytokinins (Sattar and Gaur, 1987) [13]. Plant height was observed more in combine application of Azotobacter, PSB, Rock phosphate and FYM due to steady supply of nutrients and better uptake of nutrients by plants. Innoculation of biofertilizers along with FYM and RP recorded highest fruit girth size, fruit weight and fruit length compared to control due to balanced C/N ratio and increased in synthesis of carbohydrates (Bodamwal *et al*. 2006; Bairwa *et al*. 2009 and Shelar *et al*. 2011) [3, 1, 15]. Days to first flowering and picking was recorded early in the treatment plots. This might be due to bio-fertilization that helped plants to induced cytokinin synthesis and rapid assimilation of photosynthates resulting in early transformation of the axillary bulb from vegetative to reproductive phase. Similar findings were reported in roses by Preethi *et al*. 1999 [12]. The conjoint application of FYM and biofertilizers obtained increased in yield over farmers practice. Dar *et al*. 2010 [6] reported that biofertilizers might have acted complementary and supplementary to each other and resulted in adequate and slow, but steady supply of nutrients.

The synergistic effects of organic manures and biofertilizers make more nutrients available to the plants by improving the soil physical condition and solubilizing the nutrients in soil. Better availability of nutrients at vital growth period, synthesis of carbohydrates, their proper translocation and improved water status of plants might have enabled the plant to put up better vegetative growth and profuse flowering combine with high fruit set resulting high numbers of fruit per plant and thereby increase in yield.

More over addition of biofertilizers might have increased various endogenous hormonal levels which in turn enhanced the pollen germination and tube growth (Prabhu ***et*** *al*. 2006) [10]. This might have stimulated the plants to produce productive flowers ultimately resulting in fruits per plant and increased yield. Similar findings were reported in okra by Prasad *et al*. 2017 [11]. Moisture content was observed more in the treated plots compared to the farmers practice due to more uptake of water and nutrients from soil for additional organics nutrients which improves holding capacity, porosity of soil resulted in improvement of physical and biological properties of soil and hence shelf life of fruit also increases (Sharma *et al*. 2005) [14].

Table 1: Growth & Quality Parameters

Location	variety	Plant height (cm)		Fruit length (cm)		Fruit Girth (cm)		Days to first flowering (days)		Days to first picking (days)		Self life of fruits (Days)		Moisture content of fruits (%)	
		Demo	FP	Demo	FP	Demo	FP	Demo	FP	Demo	FP	Demo	FP	Demo	FP
Farm 1	Arka Anamika	138	115	15	11	4.2	3.0	25	30	50	57	6.14	4.12	79	73
Farm 2	Arka Anamika	129	107	17	13	3.8	3.2	26	32	51	59	5.99	3.68	78	71

Table 2: Yield parameters

Location	Variety	Average weight of fruit(g)		Average yield (q/ha)		% In increase yield
		Demo	FP	Demo	FP	
Farm 1	Arka Anamika	13.26	9.47	95.9	78.3	22.47
Farm 2	Arka Anamika	11.56	8.77	92.2	72.0	28.05

It is evident from (Table-3) the technology gap, was observed 54.1q/ha and 57.8q/ha in the both the farm 1 and 2 respectively which indicates there is technical gap with the conventional method of cultivation showed difference in the yield compared to the framers practice for not following proper cultivation practice(Table 4).

Table 3: Technological gap, Extension gap and Technological index

Location	Technological gap q/ha	Extension gap q/ha	Technological index (%)
Farm 1	54.1	17.6	36.06
Farm 2	57.8	20.2	38.53

Table 4: Difference between demonstration package and farmers practice

	Particulars	Demonstration Package	Farmers practices (Local check)
1.	Variety	Arka Anamika	Arka Anamika
2.	Sowing method	Crop geometry 50cm x 45 cm	Crop geometry 30cm x20 cm
3.	Seed treatment	Azotobacter+PSB@each 7.5g/100g seeds	Not done
4.	Application of FYM and nutrients	Before sowing FYMt@5t/ha + Rock Phosphate@320kg/ha+ biofertilizers were applied in the soil as basal application.	FYM only
5.	Cultural operations	Weeding is followed timely.	Do not follow timely weeding
6.	Pest management	Azadaractin0.03%WSP 5g/lit	Use chemical insecticides

The successful development, dissemination and adoption of improved technologies for small-farmers depend careful planning of research and the use of appropriate methodologies in extension (Cramb, 2003; Biggs and Smith, 1998) [5, 2]. Extension yield gaps indicate less adoption of improved farm technologies by the farmers due to lack of awareness. Extension gap of 17. 6q/ha and 20.2q/ha was observed during the trial which emphasized the need to aware and motivate the farmers for adoption of improved farming technologies through various extension activities i.e. on farm trial, front line demonstration and trainings on improved organic production technology of vegetable crops and its management against diseases and pest to truncate the extension gap. Technology index shows the feasibility of the improved technology at the farmer's field under existing agro-climatic situations (Vedna 2007; Choudhary 2009) [8, 4]. The feasibility of improved farm technology under farmers' fields is more with lower technology index. The technology index recorded 36.06 per cent and 38.53 per cent in both the farms (Table 3) during the programme which shows the efficacy of good performance of technical interventions. This will accelerate the adoption of demonstrated technology to increase the yield performance of okra using organic inputs

Table 5: Economics organic okra cultivation

Location	Economics of Demo				Economics of FP			
	GR	GC	NR	B:C	GR	GC	NR	B:C
Farm 1	115080	34000	81080	2.38	78300	29000	49300	1.70
Farm 2	129080	38500	90580	2.35	75600	31000	44600	1.43

From Table 5 revealed that the average net return per hectare recorded Rs. 81,080.00 and Rs. 90,580.00, while from the local check Rs. 49,300.00 and Rs. 44,600.00 in both the farms. The benefit cost ratio of the experiment and local check were observed 2.38, 1.70 and 2.35, 1.43 in farm 1 and farm 2 respectively. This may be due to higher yield obtained under improved technologies compared to farmer's practice. Similar findings were reported by (Kacha and Patel, 2015) [7]. Overall, economic analysis of data inferred that transfer of improved technology and its adoption in okra may substantially enhance the profitability on farmer's field which in turn can lead to better livelihood option for farmers under the districts as well as other agro-ecological regions.

Conclusion

The present study revealed that there is increase in growth and yield parameters of okra with the use of recommended organic inputs over farmers practice. There exists a gap between potential yields, demonstration yields and farmers' yield. This indicates the feasibility of recommended organic technologies in the farmers' fields under existing agro climatic situations of both the villages of Dibrugarh and Sivasagar district. Extension gap indicates that there is a need to aware and motivate the farmers to adopt recommended technologies over existing local technologies. From the above findings, it can be concluded that by use of different recommended organic inputs the income and livelihood of the farmers can be increased sustainably. Moreover there is a need to aware and motivate the farmers through different extension activities like on farm trial, front line demonstration and trainings on improved organic production technologies and their management against different diseases and pests to reduce the extension gap.

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