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Effect of farm yard manure and planting densities on growth, yield and quality of okra under natural farming

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ABSTRACT

A field study was conducted to investigate the effect of farm yard manure and planting densities (P x P 10, 15, 20 and 25 cm and R x R 60 cm) under natural farming condition at National Agricultural Research Centre, Islamabad during 2016. The land was incorporated with well rotten farm yard manure (FYM) @ 25 t ha⁻¹ in respective plots (4 x 8 meter) one week before bed preparation and mixed thoroughly in the soil. Seeds of okra (*Abelmoschus esculentus* L., var. Pusa Green) were sown according to the plan following split plot design with four replications. The crop was allowed to stand till maturity and data on growth traits were recorded. Among plant densities, 10 and 15 cm P x P and FYM incorporation @ 25 t ha⁻¹ produced comparable fresh pod yield (11.22 and 10.97 t ha⁻¹, respectively) which was 25 and 24 % higher than that of without FYM application. Dense populated crop i.e., 10 and 15 cm P x P performed better than rest of planting densities through improved fresh pod yield with comparatively improved quality. Dense populated treatment (P x P 10 cm) and FYM application @ 25 t ha⁻¹ produced better quality fruits with less crude fiber content (9.89 %) and higher moisture content (79.14%) as compared to without FYM application (10.93 and 77.49 %) respectively that indicates more accumulation of dry matter content in fruits.

KEYWORDS: Okra, organic farming, planting densities, farm yard manure, growth, fresh pod yield, quality

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INTRODUCTION

Among rapidly consumed vegetables, okra is one popular green crop in Pakistan grown during spring summer season. As the plant life cycle falls in short duration crops, proper plant nutrition for high yielding varieties influence greatly on the production and quality traits of okra. To regulate high quality fruiting and sufficient picking adequate minerals are essential for potential fruit yield required by okra plant. Trend of intense cultivation of agricultural crops resulted in the degradation of fertile land. Recently awareness of organic farming and sustainable agriculture is taking charge over intensive farming systems around the globe. Organic manure is one of the best choices to full fill the needs of plant essential mineral nutrition for enhanced quality and crop yielding, along with properties of improving soil structure, texture and moisture holding capacity [1]. Although the amount of micro minerals is reasonable in organic manures as compared to inorganic fertilizers, existence of growth promoting components like hormones and enzymes besides mineral nutrition of plants makes them essential [2]. It is well known fact that farm yard

manure (FYM) definitely improves the soil to sustain the nutrient status [3,4,5]. Use of manure from animal and plant origin is most common practice for sustainable and organic farming around the globe. Besides, proper plant population in a field is an important aspect affecting the yield of okra. The effect of organic amendments in okra [6-11] are documented with respect to various parameters.

Keeping in mind these facts, a field experiment was planned to assess the effects of farm yard manure and plant density on yield and quality of okra to determine the optimum population for maximum fruit yield production with better quality attributes of okra var. Pusa green under natural farming environment.

MATERIALS AND METHOD

A Field study was carried out to investigate the effect of farm yard manure (FYM) and planting densities (P x P = 10, 15, 20 and 25 cm and R x R = 60 cm) under natural farming condition during dry season 2016 at National Agricultural Research

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Centre, Islamabad. The land was incorporated with well rotten farm yard manure (FYM) @ 25 t ha⁻¹ in respective plots (4 x 8 meter) one week before bed preparation and mixed thoroughly in the soil. The experiment was laid out according to split plot design with four replications. Four seeds of okra (*Abelmoschus esculentus* L., var. Pusa Green) were directly sown per hole at a depth of 2 cm. Soil physical and chemical characteristics were determined (Table 1). The samples were analyzed for soil textural class by hydrometer method [12]. Calcium carbonate was estimated by acid neutralization method and soil organic matter by oxidation with potassium dichromate in sulfuric acid medium under standardized conditions by Walkley and Black procedure [13]. Soil pH and Electrical conductivity (ECe) were measured. The P, K and Zn were determined by using AB-DTPA method [14]. The crop was allowed to stand till maturity and

data on growth characters were recorded. The quality characters like crude fiber and moisture percentage were estimated. The data thus collected were subjected to statistical analysis and treatment differences were compared by using LSD [15].

RESULTS AND DISCUSSION

All the treatments of FYM application @ 25 t ha⁻¹ along with dens plantation performed significantly in terms of plant height, pods plant⁻¹, pod yield (t ha⁻¹), crude fiber contents (%) and moisture contents (%) over non FYM treatments and less dense okra population. Data in Tables 2, 3 and 4 registered statistically significant increase in okra plant growth, yield and quality among all treatments receiving FYM over control treatments (without FYM) and dense population. Results listed in Table 2 advocate that treatment receiving FYM @ 25 t ha⁻¹ showed maximum plant height 54.34 (cm) and peak number of pods plant⁻¹ 23.77. Similar findings were reported by Premsekhar and Rajashree [16] in response to the FYM application in okra farming.

Results mentioned in Table 3 indicate that FYM applied treatments produced significantly higher fresh pod yield (11.22 t ha⁻¹ and 10.97 t ha⁻¹) of okra plated with 10 and 15 cm planting distances, respectively against 10.97 t ha⁻¹ and 8.81 t ha⁻¹ under same planting densities without FYM application. Comparatively less fresh pod yield under no FYM application might be due to lack of nutrients resulting in reduced growth and yield. The positive effect of FYM on plant growth and yield could be due to the contribution made by manure to fertility status of the soil as the soils were low in organic matter (Table 1). FYM as compared to control treatment (without FYM) could be due to the presence of nutrients in the soil which satisfied plants requirements for their health growth. Okra production organic manure could increase plant height of crops [9]. Similar findings had also been reported by Premsekhar and Rajashree [16]. Furthermore, higher and statically significant values of fresh pod length (9.98 cm) and fresh pod weight (45.92 g) of okra under normal plant population (20 x 20 cm) were recorded. On an average, FYM @ 25 t ha⁻¹ application also showed elevated pod length (9.52 cm) and weight of fresh pod (44.65 g pod⁻¹), respectively as compared to non FYM treated plots. An opposite trend was observed regarding quality of okra pod fruits in terms of minimum crude fiber (8.87 %) and higher moisture (78.90 %) contents harvested from FYM treated (25 t ha⁻¹) under dense populated okra plants (Table 4), as okra pods are found to be the best for cooking and consumption with lesser crude fiber contents. Previous findings of Dileep [5], Gopalakrishnan [17]

Table 1: Physico-chemical characteristics of the soil (0-30 cm) at the experimental site in 2016 at NARC, Islamabad

Parameters	Unit	Values	
		Before Sowing	After Harvest
pH	—	8.64	8.51
ECe	dS m ⁻¹	0.32	0.29
CaCO ₃	%	4.87	4.84
OM	%	0.35	0.38
NO ₃ -N	%	2.72	3.19
Extractable P (AB-DTPA)	mg kg ⁻¹	2.16	2.74
Extractable K (AB-DTPA)	mg kg ⁻¹	84.73	85.57
Zn (ABDTPA)	mg kg ⁻¹	1.78	2.01
Sand	%	31.70	31.70
Silt	%	28.29	28.29
Clay	%	40.11	40.11
Textural Class	—	Sandy clay loam	Sandy clay loam

Table 2: Plant height and number of pods of okra as affected by farm yard manure and planting densities during 2016 (Average of three Repeats)

Planting Densities	Plant Height (cm)		Mean	Number of Pods Plant ⁻¹		Mean
	+ FYM	- FYM		+ FYM	- FYM	
10 cm	55.10 a	34.25 c	44.68 ^{NS}	21.63 b	14.43 d	18.03 B
15 cm	54.45 ab	34.19 c	44.32	22.65 ab	15.68 cd	19.17AB
20 cm	53.93 ab	33.98 c	43.96	24.87 a	17.67 c	21.27 A
25 cm	53.88 ab	33.87 c	43.88	25.92 a	17.84 c	21.88 A
Mean	54.34 A	34.07 B		23.77 A	16.41 B	

Means bearing same letter (s) in each column are statistically similar at P ≤ 0.05

Table 3: Pod length, fresh pod weight and fresh pod yield of okra as affected by farm yard manure and planting densities during 2016 (Average of three Repeats)

Planting Densities	Pod Length (cm)		Mean	Fresh Weight Pod ⁻¹ (g)		Mean	Fresh Pod Yield (t ha ⁻¹)		Mean
	+ FYM	- FYM		+ FYM	- FYM		+ FYM	- FYM	
10 cm	9.13 a	5.17 ab	7.15 AB	43.25 b	26.59 cd	34.92 B	11.22 ab	10.97 bc	11.10 A
15 cm	9.14 a	5.12 b	7.13 AB	43.99 b	26.87 cd	35.43 B	10.97 bc	8.81 c	9.89 B
20 cm	9.84 ab	5.67 bc	7.83 A	45.44 ab	28.78 c	37.11 A	9.46 c	7.98 c	8.72 BC
25 cm	9.98 ab	6.28 c	8.06 A	45.92 a	29.46 c	37.69 A	8.25 c	7.52 cd	7.89 C
Mean	9.52 A	5.56 B		44.65 A	27.93 B		9.98 A	8.82 B	

Means bearing same letter (s) in each column are statistically similar at P ≤ 0.05

Table 4: Crude fiber and moisture content of okra as affected by farm yard manure and planting densities during 2016 (Average of three Repeats)

Planting Densities	Crude Fiber Content (%)		Mean	Moisture Content (%)		Mean
	+ FYM	- FYM		+ FYM	- FYM	
10 cm	9.89 b	10.93 a	10.01 ^{NS}	79.14 ^{NS}	77.49	78.32 ^{NS}
15 cm	9.14 b	10.91 a	9.68	78.87	77.41	78.14
20 cm	8.59 bc	11.14 a	9.97	78.79	77.43	78.11
25 cm	7.84 c	11.18 a	9.56	78.78	77.24	78.01
Mean	8.87 B	10.74 A		78.90 ^{NS}	77.39	

Means bearing same letter (s) in each column are statistically similar at $P \leq 0.05$

and Tihamiyu et al. [18] are in line with our results who reported that FYM increased yield and quality of vegetables providing healthy environment and good soil structure and texture.

Both interventions FYM and planting densities yielded significant mean fresh pod yield increase 13% and 12% with application of FYM @ 25 t ha⁻¹ and planting density P x P 10 cm as compared to no FYM application and planting densities P x P 15 cm, respectively. The mean fresh pod yield was improved with P x P 10 cm significantly 41% over planting densities P x P 25 cm. The fundamental reason for the improved fresh pod yield might be owing to higher plant population that might have recompensed the fresh pod yield. Similar reports were made previously in okra with different organic amendments [9-11].

Further FYM definitely provided favorable environment for health growth and ultimately higher yield. Comparatively the superior quality in okra may be due to FYM application resulting in improved nutritional availability of soil in terms of NO₃, H₂PO₄ and trace elements (Zn, Cu, Fe, Mn and Mg) availability, which has significantly improved chlorophyll content in leaves, several biochemical components and coenzymes were being more active in response to trace elements that ultimately enhanced the photosynthetic and metabolic activities that promoted higher cell division giving maximum yield, current findings are in settlement to the reported material of [19-21].

CONCLUSION

Current experimentation has revealed that farm yard manure (FYM) application @ 25 t ha⁻¹ actively enhanced vegetative growth, increased yield and improved pod quality traits of okra. In addition, dense plantation (P x P 10 cm) improved fresh pod yield per unit area of okra vegetable. For attaining a higher yield and maximum quality of okra FYM @ 25 t ha⁻¹ application and plantation at higher density (P x P 10 cm) could be a very effective protocol for organic and sustainable farming under natural farming.

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