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Response of Okra (*Abelmoschus esculentus* (L) Moench) to Soil Types from different Agroecological Zones of Nigeria.

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ABSTRACT: In order to study the effect of variety and soil types on growth, fruit and seed yield of okra, two pot experiments were conducted at Ibadan from October, 1999 to May, 2000. In each experiment, the treatments consisted of two varieties of okra (NHAe-47-4 and LD 88) and four soil types (collected from Oyo, Ondo, Edo and Kano states of Nigeria). The experiment was laid out in a randomised complete block with four replications. Data were collected on growth, fruit and seed yield parameters. Varietal effect was significant on root length, root and fruit dry weight in 1999 and only on number of leaves/plant and fruit yield in 2000. In both years and for most parameters, LD 88 performed significantly better than NHAe-47-4. The fruit yield produced by LD88 in 2000 (9.23t/ha) was significantly ($p = 0.05$) higher than that of NHAe-47-4 (6.37t/ha). Also soil types had significant effect on most parameters considered. Oyo Soil produced the most luxuriant growth which significantly ($p = 0.05$) differed from other soil types. In case of fruit yield, the highest fruit yield of 8.71t/ha was produced from Oyo soil while the least (3.54t/ha) was obtained from okra plant grown on Kano soil. Soil types and variety interaction were significant for most of the parameters considered. The NHAe-47-4X Oyo soil gave the best interactive effects while NHAe-47-4 with Kano soil gave the least. From the results it can be concluded that soil types can set limit to okra performance and the effect becomes pronounced if the soil is of inherent low fertility.

Key words: Growth, okra, soil type, variety.

INTRODUCTION

Okra, *Abelmoschus esculentus* L (Moench) is an important vegetable crop in the tropics, Nigeria inclusive. It is frequently included in the daily dietary formulation. When cooked fresh, the okra pod contains approximately 86.1% water, 2.2% protein, 0.2% fat, 9.7% carbohydrate, 1.0% fibre and 0.8% ash (Purseglove, 1992). In Nigeria, okra production is mainly by peasant farmers. Okra fruit yield on farmers plot is far below the yield realizable under research conditions. Parts of the reasons for this low yield includes non-adaptability of the variety cultivated in different areas coupled with vagaries in soil conditions (Harman, *et al.*, 1990).

Soil is the major components of land, and the potential yield of a crop can only be realised through a proper integration of crop variety, climate and soil management. Majority of the soils in humid tropical Africa are infertile (Palm and Sanchez, 1991), thus, a considerable portion of agricultural soils especially in Nigeria can be classified as low fertile soil. The development of new technology, use of mineral fertilizers, introduction of tillage, increase in cropping intensity and the reduction of fallow systems are agents that deplete soils of valuable nutrients (Obi, 1987). In Nigeria, the severity of these agents of soil depletion varies from one geographical location to another and this accounts for differences in soil fertility gradient across the country. The obvious consequence of this is variation in performance of crops grown on the soil. Apart from this, soil parent rock and microbial activities have influence on the nature and fertility level of soil in a particular location. This will subsequently affect both the availability and plant uptake of essential nutrients (Sartain, 1985; Aghatise, 1992).

Apart from soil factor, another important determinant of crop performance is the crop species variety. This has been recognised in wheat (Kiss *et. al, 1990)*, maize (Moll *et al.*, 1982), rice (Yoneyama *et al.* 1989) and tomato (Adelana, 1985). Kiss *et. al*, (1990) reported that dry matter accumulation, nutrient uptake and utilization efficiency, and yield depend on wheat variety. The variety with greater root growth and rooting pattern was found to perform better. This attributes enhance higher water and nutrient extraction (Moll *et al.*, 1982; Kiss *et. al*, 1990), improves the use efficiency of applied nutrients and have positive impacts on plant vegetative development and yield (Yoneyama *et al.* 1989).

The objective of the study was to assess the performance of two varieties of okra in different Nigerian soil types.

MATERIALS AND METHOD

Two potted experiments were conducted to determine the effect of variety and soil type on the growth, fruit

and seed yield of okra at the roof top of the Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan from October, 1999 to May 2000.

The treatments consisted of two varieties of okra (NHAe 47-4 and LD 88) and four soil types (collected from Oyo, Ondo, Edo and Kano States). The seeds of the two varieties of okra used were collected from National Institute of Horticultural Research, Ibadan. Each soil type was analysed for physical and chemical properties before use and the results are presented in Table 1. The experimental design was a 2 x 4 factorial experiment laid out in a randomised complete block design with four replications.

Five litre size plastic pots were used for the experiments. Each pot was perforated at the bottom and lined with cotton wool to control drainage and aeration. Each pot was filled with 5kg soil leaving about 5cm to the brim to conveniently permit watering. A treatment consisted of 10 such pots.

Four seeds of each variety of okra were sown on October 25, 1999 and January 26, for first and second planting respectively. The seedlings were thinned to two plants per pot after establishment. Watering and weeding were done as required and spraying with Cymbush at the rate of 2ml/l of water controlled insect pests. Spraying was done fortnightly starting from 2 weeks after sowing (WAS) till onset of fruiting.

At 7 WAS, the stem height, root length, number of leaves and leaf area were measured. The stem height was taken from the soil surface to the last node while leaf area was estimated by the length of midrib method (Olasantan, 1999). For the determination of dry matter yield, 5 plants per treatment were uprooted at 7 WAS and cut into parts. Then, the stem, root and leaves were bagged separately in brown envelope and dried in oven at 80°C to constant weight after which dry matter yield was determined.

Green immature okra pods were harvested and numbers and fresh weights recorded immediately every 3 days, starting from December 15 (8WAS) in the first and March 18 (8WAS) in the second plantings. Pods without blemish with at least 3.5cm in length were regarded as marketable.

For dry seed yield determination, another five plants per treatment were selected, allowed to bear fruits and the fruits were left to air-dry on the plant. The fruits were harvested, opened and seeds collected, counted and weighed to determine seed yield.

Data from each cropping cycle were subjected to analysis of variance (ANOVA) and least significant difference (LSD) at 5% probability value were used to compare the treatment means. Data on seed yield attributes were presented for 2000 experiment only.

RESULTS AND DISCUSSION

The general chemical and physical properties of the four soil types used for the experiment are presented in Table 1. All the soil types were slightly acidic with pH (water) ranges from 4.4 in Edo soil, 5.0 in Kano soil to 5.2 in Ondo soil. Soil organic carbon was

Table 1: Pre-cropping physical and chemical Characteristics of experimental soils.

		Sources of soil			
		Oyo	Akure	Edo	Kano
pH*		5.1	5.2	4.4	5.0
Mechanical analysis (%)	Sand	79.0	81.0	67.0	92.0
	Silt	12.0	13.0	7.0	2.0
	clay	9.0	6.0	26.0	6.0
C(%)		1.53	2.10	1.07	0.43
N (%)		0.21	0.16	0.11	0.03
AV. P(%)		5.50	5.50	5.50	2.25
Exchange-able bases (Me/100g)	Ca	0.77	8.29	0.71	1.36
	Mg	0.33	1.87	0.35	0.60
	K	0.33	1.87	0.35	0.60
	Na	0.14	0.14	0.15	0.13
	H+	0.24	0.32	0.56	0.48
	CEC	1.62	10.79	1.88	2.63

*pH in 1:10 distilled water.

lowest (0.43%) in Kano soil and highest (2.10%) in Ondo soil. The total nitrogen were 0.03, 0.1, 0.16 to 0.21% in Kano, Edo, Ondo and Oyo soil respectively. The %N in Kano was relatively sub-optimal using a critical value of 0.06% which is considered as optimum for okra (NIHORT, 1983). Available P (Bray P) was 5.50 mg/kg in Ondo, Oyo and Edo soil while that of Kano soil was 2.25mg/kg. The P content of Kano soil was low considering the recommendation of 5 to 8mg/kg critical P for okra (Fatokun and Chheda, 1983). This analytical results of soil type revealed that Kano soil is inherently infertile for it is deficient in most of the essential nutrients required for optimum production of the test plant.

Table 2 presents the simple effect of variety on the growth and yield attributes of okra that were found to be significant in the two experiments. In 1999, among all the growth parameters taken, only root length, root dry weight and fruit dry weight were significantly affected by the variety. In the second cropping (2,000 experiment) number of leaves/plant, number of nodes/plant and fruit yield were significantly influenced by the variety. Variety LD88 was superior to NHAe-47-4 in term of root length, root dry weight, fruit dry weight and fruit yield. LD88 produced 9.23 t/ha fruit yield which is 45% significantly higher than the fruit yield produced by NHAe-47-4. Varietal effect as it influences crop performance had been reported by many researchers (Moll *et al.*, 1982; Adelana, 1985; Yoneyama, *et al.* 1989; Kiss *et al.* 1990). Variation in the genetic make up may be the cause of differences in crop variety performance. For instance, differences in leaf area production, dry matter partitioning into the fruit and uptake of nutrient had been indicted to be the source

of yield variation in some variety of tomato (Adelana, 1985). In another study, efficiency in root formation, root longevity and nutrient uptake and utilization were found to be the reasons for different growth and yield

Table 2: Simple effect of variety on some significant growth and Yield attributes of Okra in 1999 and 2000 pot experiments

Parameter	NHAe-47-4	LD 88	Mean	Variety Prob of F.	LSD (p≤ 0.05)
		1999 Trial			
Root length (cm)	8.54	9.94	9.94	*	1.34
Root dry weight (g)	0.58	0.77	0.67	*	0.19
Fruit dry weight (g)	5.72	6.38	6.00	**	0.54
		2000 Trial			
Leaf area (cm^2/plt)	222.40	291.67	257.04	Ns	92.26
Number of leaves/plt	4.07	5.13	4.61	*	1.02
Number of nodes/plt	7.44	8.50	7.97	**	0.69
Fruit yield (t/ha)	6.37	9.23	7.80	**	1.98

*, ** =Significant at 0.05 and 0.01 probability levels respectively; ns=non significantly different p≤0.05.

performance among wheat variety (Kiss, *et al.* 1990). LD88 produced taller plants with wider leaf area and more number of leaves. This may be the reason for higher photosynthetic activities and partitioning of more assimilates into the fruits (Table 2). All these improved the growth of the variety and culminated into higher fruit yield.

Okra growth fruits and seeds parameters taken in response to soil types are shown in Tables 3 and 4. In 1999, soil types had significant effect on most parameters taken. The vegetative growth of the test plants were in line with the fertility of the soil types. Generally, Oyo soil consistently produced significantly higher values over other soil types for most of the parameters. Okra plant grown in Oyo soil had the tallest height (37.51cm) while the least (14.53cm) was observed from Kano soil. The variation in leaf area was in order of Oyo > Akure > Edo > Kano soil. The Oyo soil produced plants with widest leaf area (419.51cm^2) while the least (52.20cm^2) was obtained from plant grown on Kano soil. The trend observed for leaf area was also observed for dry matter production and partitioning. The plant grown on Oyo soil produced highest root, shoot and leaf dry matter yield which are significantly higher than that obtained from Akure, Edo and Kano soil grown plants. In as much as fruit yield is concerned, Oyo soil produced the highest fruit yield of 8.71 and 7.60 t/ha in 1999 and 2000 cropping cycles respectively. The fruit yield from Oyo soil, in 1999 was significantly higher than that of other soil types. However, in 2000, the fruit yield obtained from Oyo and Akure soils (7.60 and 6.33t/ha respectively) were not significantly different but the values from these 2 soil types were significantly higher than what obtained from the other soil types.

Okra seed production was equally influenced significantly by the soil type. The number of seed/plant, seed weight/plant and seed yield were all highest in Oyo soil grown plants and was 72.25kg/ha while 65.75, 52.79 and 47.54kg/ha were obtained from Akure, Edo and Kano soil grown plant respectively. In most cases, the seed parameters response to Oyo and Akure soil was not significantly different.

Positive correlation between the soil nutrient contents and crop yield had been reported (Obi, 1987; Agboola and Sobulo, 1981). The quantity of nutrients readily available for plant use in the soil could set limit to plant performance. The higher level of nutrients in Oyo and Akure soils may be the reasons for better performance of plant grown on them. When the nutrients in the soil is not limiting, more nutrients will be made available for plant use. This may also have positive effects on plant root development, rooting pattern and root longevity which favours nutrient uptake (*Sartain, 1985*). Thus, availability of adequate amount of nutrients in Oyo soil favours the growth, fruit and seed yield of the okra plants grown on it. With reduction in soil nutrient contents (especially in Edo and Kano soils), there were significant reductions in growth, fruit and seed components. This forms the basis for poor performance of plants grown an these soil types and agrees with the report of Aghatise (1992) that variation in the supply of nutrients affects the growth of plants and may lead to changes in the components of fruit and seed yield.

Tables 5 and 6 contained the interactive effect of soil type and okra variety on some growth, fruit and seed components in 1999 and 2000 experiments. In both experiments, the interactive effect was significant on all the parameters considered. Among the two way interactions, in both years, variety LD 88 grown in Oyo soil had the most luxuriant growth, dry matter, fruit and seed yield. The two okra varieties performed similarly on each soil type. But across the soil type, variety LD88 grown on Oyo soil produced the highest fruit yield of 9.02t/ha while the least (3.08t/ha) was obtained with NHAe 47-4 grown on Kano soil. This implies that irrespective of crop

variety soil inherent fertility set limits to crop performance.

From the results of this study, it can be concluded that soil nutrient contents set limit to crop performance and this becomes more pronounced if the crop variety is less adapted to the soil.

Table 3: Simple effect of soil types on some significant growth and fruit yield attributes of okra in pot experiment (1999)

Parameters	Soil Types				Mean	Prob. of F	LSD ($p \leq 0.05$)
	Oyo	Akure	Edo	Kano			
Stem height (cm)	37.51	27.94	16.96	14.53	24.23	**	3.58
Root length (cm)	11.86	10.30	9.25	5.54	9.24	**	1.89
Leaf area/plant(cm^2)	419.51	261.25	107.80	52.20	210.19	**	86.03
Number of leaves/plant	6.00	5.25	3.75	4.12	4.78	**	0.87
Number of nodes/plant	9.13	8.63	7.75	6.63	8.03	**	0.56
Stem dry matter (g)	3.56	2.06	0.76	0.31	1.67	**	0.95
Root dry matter (g)	1.36	0.83	0.33	0.14	0.67	**	0.26
Leaf dry matter (g)	1.86	1.55	0.57	0.27	1.06	**	0.29
Number of fruit/plant	2.00	1.38	1.00	1.00	1.34	**	0.62
Fruit yield (t/ha)	8.71	6.81	4.35	3.54	6.00	**	1.00

** = Significant at 0.01 probability level.

Table 4: Simple effect of soil types on some growth, fruit and seed yield of okra in pot experiment (2000)

Parameters	Soil Types				Mean	Prob. of F	LSD ($p \leq 0.05$)
	Oyo	Akure	Edo	Kano			
Stem height (cm)	21.16	20.00	15.53	15.01	17.93	**	2.67
Root length (cm)	19.98	19.44	13.41	10.34	15.79	**	3.40
Leaf area/plant(cm^2)	415.56	306.56	172.45	133.58	257.54	**	130.48
Root dry matter (g)	0.77	0.82	0.35	0.19	0.53	**	0.31
Stem dry matter (g)	1.66	1.74	0.70	0.64	1.19	**	0.55
Leaf dry matter (g)	1.65	1.41	0.83	0.80	1.17	**	0.46
Fruit dry matter (g)	0.85	1.14	0.58	0.44	0.76	**	0.26
Fruit yield (t/ha)	7.60	6.33	5.87	4.29	6.83	*	2.81
No of seed/plant	42.63	29.25	27.38	26.00	31.48	*	13.42
Seed weight/plant(g)	1.41	1.23	0.99	0.89	1.14	*	0.45
Seed yield (kg/ha)	72.25	65.75	52.79	47.54	60.75	*	34.65

*, ** = Significant at 0.05 and 0.01 probability level respectively.

Table 5: Soil types and variety interactive effects on some growth and fruit yield attribute of okra in pot experiment (1999)

oil Types	Variety (V)	Stem height (cm)	Root length (cm)	Number of leaves/plant	Number of node/plant	Leaf area/ plant (cm^2)	Root dry weight (g)	Stem dry weight (g)	Leaf dry weight (g)	No of fruit/plant	Fruit yield (t/ha)
yo	NHAe-47-4	35.75	10.83	6.25	9.00	435.14	1.08	3.91	1.89	2.00	9.02
	LD88	39.28	12.93	5.75	9.25	403.39	1.68	3.21	1.82	2.00	8.39
kure	NHAe-47-4	28.75	9.30	5.25	8.75	302.22	0.77	2.50	1.40	1.25	6.46
	LD88	27.13	11.30	5.25	8.50	220.29	0.90	1.62	1.70	1.50	7.28
do	NHAe-47-4	20.00	8.83	3.50	7.50	117.00	0.31	0.81	0.63	1.00	4.35
	LD88	13.93	9.68	4.00	8.00	98.60	0.36	0.70	0.52	1.06	4.36
ano	NHAe-47-4	13.73	5.23	3.75	6.50	52.54	0.15	0.28	0.23	1.04	3.08
	LD88	15.23	5.85	4.56	6.75	51.56	0.14	0.34	0.31	1.00	4.13
	Mean	24.23	9.24	4.78	8.03	210.19	0.67	1.67	1.06	1.34	6.01
	Prob. of F (SxV)	**	**	**	*	**	*	**	**	*	*
	LSD ($p \leq 0.05$) (SxV)	5.06	2.67	1.24	0.80	121.70	0.37	1.34	0.41	0.87	1.44

*, ** =Significant at 0.05 and 0.01 probability level respectively.

Table 6: Soil type and variety interactive effects on some growth, fruit and seed yield attributes of okra in pot experiment (2000).

oil ype(s)	Variety (V)	Stem height (cm)	Root length (cm)	Number of leaves/ plant	Number of nodes/ plant	Leaf area/ plant (cm^2)	Leaf dry weight (g)	Stem dry weight (g)	Root dry weight (g)	Fruit dry weight (g)	Fruit yield (kg/ha)	No of seed/ fruit	No of seed/plant	Seed yield (kg/ha
)yo	NHAe-47-4	22.83	21.08	4.75	8.00	363.98	1.50	1.40	0.48	0.67	6.22	30.25	52.75	77.07
	LD88	19.50	18.88	5.75	9.11	467.13	1.80	1.93	1.06	1.04	8.97	36.25	52.50	73.47
Akure	NHAe-47-4	19.63	21.03	3.67	7.75	254.65	1.37	1.65	0.82	0.87	7.29	31.50	47.50	75.16
	LD88	20.38	17.85	5.25	8.50	358.46	1.45	1.83	0.82	1.35	10.86	27.00	38.00	55.33
Edo	NHAe-47-4	15.68	12.18	3.25	6.75	153.00	0.72	0.70	0.33	0.85	8.63	37.50	47.50	66.67
	LD88	15.38	14.65	4.75	8.00	191.90	0.94	0.70	0.38	0.45	4.49	17.25	29.25	38.92
Kano	NHAe-47-4	15.00	9.50	4.50	7.25	117.98	0.76	0.52	0.17	0.48	4.71	28.25	38.25	50.80
	LD88	15.03	11.18	4.75	8.50	149.19	0.83	0.77	0.22	0.38	3.72	23.00	33.00	43.20
	Mean	17.92	15.79	4.61	7.97	257.04	1.17	1.19	0.53	0.76	6.83	29.06	41.48	60.75
	Prob. of F (SxV)	**	*	**	**	**	*	*	**	*	**	*	**	**
	LSD($p \leq 0.05$ (SxV)	3.78	4.81	2.04	1.39	184.53	0.65	0.78	0.43	0.38	4.06	17.15	19.03	36.10

*, **=Significant at 0.05 and 0.01 probability level respectively.

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