TERTIARY EDUCATION TRUST FUND

AGRICULTURAL AND BIOLOGICAL SCIENCES

GROWTH AND YIELD TRAITS OF GROUNDNUT(*ARACHIS HYPOGAEA*) LINES TREATED WITH HYDROGEN PEROXIDE.

Ittah M. A., and Francis, E. E.
Department of Crop Science, Faculty of Agriculture, Forestry and Wildlife Resources Management, University of Calabar, PMB 1115, Calabar, Nigeria.

Corresponding Email: macittah@yahoo.com

Date Manuscript Received: 23/08/2015 Accepted: 11/12/2015 Published: March 2016

ABSTRACT

The response of some growth and yield traits of four groundnut cultivars, Ms 54-76, ICGV-Sm-42, RmP 12 and Samnut 21 treated with hydrogen peroxide for 24 hours prior to planting was studied using seed treatmentof 0%, 0.5%, 1%, 2% and 3%of hydrogen peroxide (H_2O_2). The treated seeds were planted in a split plot experimental designing a completely randomised design (CRD) using three replications in University of Calabar, Nigeria. Results showed that more seedlings of Ms 54-76, ICGV-Sm-42 and RmP 12 were established than Samnut 21 at fourteen days after planting. There was a similar variation in the number of days to 50% flowering, number of pods per plant, plant height, number of leaves, number of branches, and weight of pods per plant, shelling percentage and seed weight. The H_2O_2 incited increase in the seed germination, plant height and in seeds weight from 8 weeks after planting upwards. Generally, ICGV-Sm-42 had the most luxuriant growth and superior yield of the four varieties, followed by Sm-54-76 and RmP 12.ICGV-Sm-42 had the highest response to seed treatment with hydrogen peroxide.

Keywords: *Hydrogen peroxide; ArachishypogaeaL; physiological stimulant; crop yield; mutagen.*

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the very important grain legumes in the tropical cropping system, especially in Africa, whereit is grown mainly by smallholder farmers. China, India and Nigeria are the leading producers of groundnut in the world (IFST, 1999; FAO/IAEA, 2004). Tweneboah (2000) reported that out of 6 million tonnes of groundnuts produced in Africa, about 80% comes from the savannah zone, south of the Sahara and only 5% from the equivalent zone in the Southern hemisphere. Nigeria, Senegal, Niger and the Sudan are the four largest groundnut producers in Africa.

Groundnut is the 13th most important food crop of the world, the 4th most important source of edible oil and 3rd most important source of vegetable protein (Tarawali and Quee, 2014). Groundnut seeds contain high quality edible oil (50%), easily digestible protein (25%) and carbohydrate (20%). It is grown on 26.4 million/ha worldwide with a total production of 36.1 million metric tons, and an average productivity of 1.4 metric tons ha-1 (FAO/IAEA, 2004, Shiyam, 2010, Showemimo *et al*., 2012, Tarawali and Quee, 2014). In Nigeria, groundnut has lost its position as a crop of prominence due to emphasis shift to the petroleum industry, although, there is a current effort to restore its production.

Recent genetic improvement of groundnut crop cannot be fully exploited because report has it that yield in groundnut has not significantly improved over time and this could be attributed to its narrow genetic base (People and Herridge, 1990 and Suvendu *et al*., (2007). The narrow genetic base makes it difficult to improve groundnut through conventional breeding programme, but induced mutation breeding has been reported as a means of increasing variability and enhancing crop improvement. Ritambhara and Kumar, (2011), established that mutation is a sure means for the creation of variability among plant population.Mutation have effects on physiological, biochemical, morphological and so on, traits in plants, which can be exploited for the benefit of humans.

Hydrogen peroxide (H_2O_2) has been reported to promote germination of *Zinnia elegans* L in the pericarp covering the seed within the fruit in a dose-dependent manner, as well as regulating metabolism in plants (Ślesak *et al.,* 2007).Due to its relative stability and ability to diffuse through membranes, it is able to translocate second messenger triggering Ca_2^+ fluxes, modify protein and activate gene expression in plants (Vranová *et al*., 2002). Hydrogen peroxide also regulates plant development, stress adaptation or programmed cell death (PCD). PCD itself is essential for developmental processes and environmental responses, including aleurone cell death, hypersensitive response to pathogens, and allelopathic plant to plant interactions(Gechev and Hille, 2005). These outstanding physiological stimulation attributes of H_2O_2 had prompted this study.The objective of the study was to evaluate the growth and yield characteristics of some groundnut cultivars after the seeds were treated with hydrogen peroxide for 24 hours before planting.

MATERIALS AND METHODS

The study on variation induced by hydrogen peroxide (H_2O_2) in groundnut lines wasconducted at the University of Calabar, Calabar, Nigeria. Calabar (latitude 4.24^{0}N; longitude 7.5^{0}E) situated in the humid rainforest region of southern Nigeria.

The experiment was potted with 100 polyethylene bags filled with soil weighing 11.3kg. The experimental design was a split plot arrangement in a completely randomised design (CRD) with 3 replications. The main plot was the levels of H_2O_2 (0.5%, 1.0%, 2.0%, 3.0%, and the control, without hydrogen peroxide (0 %), for 24 hours) and the four varieties of groundnut (MS 54-76, ICGV-Sm-42, RmP 12 and Samnut 21) constituted the sub plots.One hundred seeds of each variety were soaked in each concentration of H_2O_2 and the experiment was placed in the open outside the greenhouse.Datawere collected from the two plants in each bag and analysed using GenStat (2005) statistical tool and the differences between the treatments means were separated using the Least Significant Difference (LSD) at 5% level of probability.

RESULTS AND DISCUSSION

Seedling establishment of the groundnut varieties is presented in Table 1. Ms 54-76, ICGV-Sm-42 and RmP 12 were established earlier than Samnut 21. The number of branches per plant is presented in Table 2. ICGV-Sm-42, RmP 12 and Samnut 21 had significantly more branches per plant than Ms 54-76.

The plant height of the four groundnut varieties submerged in $H_2O_2$is presented in Table 3. Two varieties (ICGV-Sm-42 and RmP 12) were significantly taller than the other varieties (Ms 54-76 and Samnut21). At six WAP, the height of ICGV-Sm-42 was not different from that of Ms 54-76 but significantly taller thanRmP 12 and Samnut 21. At 8 weeks after planting (WAP),ICGV-Sm-42 at1%, 2% and3% of H_2O_2, RmP 12 at 2% and3%, and Ms 54-76 at 2% were not significantly different from each other but were significantly taller than at 0.5 per cent and the control. At ten WAP, ICGV-Sm-42 was as tall as RmP 12 and were significantly taller than Ms 54-76 and Samnut 21.

At two and four WAP, Ms 54-76 and ICGV-Sm-42 had significantly more leaves per plant than RmP 12 and Samnut 21,similar trend was observed at four and six WAP (Table 4 a-c).The number of days to 50% flowering is presented in Table 5. RmP 12 flowered first, followed by Samnut 21, ICGV-Sm-42 and then Ms 54-76.

A similar developmental trendshown in the growth curve was observed in yield traits. Ms 54-

76 had significantly more pods than the other three varieties (ICGV-Sm-42, RmP 12 and Samnut 21), ICGV-Sm-42 and Samnut 21 had more pods than RmP 12 (Table 6a). Variation in number of pods per plant is a genetic trait influenced by the environment and has been reported by other researchers (Ahmad and Mohammad,1997 and Virk *et al*., 2005).Ms 54-76 had heavier pods than ICGV-Sm-42, RmP 12 and Samnut 21 (Table 6b).

The shelling percentage in Ms 54-76 and Samnut 21 was significantly higher than in ICGV-Sm-42 and RmP 12 (Table 6c). Shelling percentage indicates the proportion of the total dry matter attributable to the seeds; it is affected by varietal factors, as well as environmental factors affecting photosynthesis, dry matter partitioning and accumulation. Abdullah *et al.,* (2007) reported ashelling percentage of 48-61%, while Virender and Kandhola, (2007) had reported 536-65% in other groundnut varieties.

Ms 54-76 had the highest seed yield (Table 6d). All the varieties, MSs 54-76, ICGV-Sm-42 and Samnut 21 had higher seed yield than RmP 12. Hydrogen peroxide influenced the weight of 100 seeds in this experiment, from 1 per cent, there was increase in the seed weight than at 0.5 % and the control (Table 6e), especially with respect to the response of Ms 54-76 and ICGV-Sm-42. Farag and Zahran (2014) had similarly observed enhanced vegetative growth and yield traits (leaf area, leaf area index, shelling percentage, number of pods and seeds) in groundnut lines from irradiation with gamma rays. This implies that hydrogen peroxide can induce physiological stimulation that will improve yield in groundnut.

According to Gechev *et al*., (2005), low doses of H_2O_2 induce stress adaptation to a new climate; such conditions as a new temperature, altitude or environment, in plants. This hypothesis was demonstrated in this study as was evident in changes that created increase in phenotypic expression, such as in height, number of leaves and seed yield in ICGV-Sm-42 and Ms 54-76.These varieties showed better response after seed soaking in hydrogen peroxide.

Table 1.Seedling establishment in groundnut whose seeds were treated with H_2O_2before planting.

H_2O_2 Level	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	Mean
0	3.80	4.00	4.00	2.00	3.45
0.5	3.80	4.00	3.60	2.20	3.40
1.0	4.00	4.00	3.80	2.40	3.55
2.0	3.60	4.00	3.80	2.20	3.40
3.0	4.00	4.00	3.00	2.60	3.40
Mean	3.84	4.00	3.64	2.28	

Key: LSD (0.05) for variety = 0.39; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2 levels =NS

Table 2.Number of branches per plantof groundnut lines treated with H_2O_2 before planting

H_2O_2 Level	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	Mean
0	4.93	6.63	7.57	6.20	6.33
0.5	5.47	6.80	5.77	6.47	6.12
1.0	5.57	6.80	6.27	6.80	6.36
2.0	5.98	5.50	6.92	5.55	5.99
3.0	6.33	6.73	6.47	6.60	6.53
Mean	5.66	6.49	6.60	6.32	

Key: LSD (0.05) for variety = 0.64; LSD for H2O2 levels = NS; LSD for variety x H2O2 levels =NS

Table 3.Plant height of groundnut linestreated with H_2O_2 before planting.

a. Plant height at 2 weeks after planting

H_2O_2Level	Variety				Mean
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	5.05	6.24	4.86	2.74	4.72
0.5	4.39	5.88	5.79	4.18	5.06
1.0	4.61	5.96	5.22	3.70	4.87
2.0	5.46	6.36	6.55	3.95	5.58
3.0	4.36	6.18	5.65	4.55	5.18
Mean	4.77	6.12	5.61	3.82	

Key: LSD (0.05) for variety = 0.58; LSD for H_2O_2levels = NS; LSD for variety x H_2O_2levels =NS

b. Plant height at 4 weeks after planting.

H_2O_2 Level	Variety				Mean
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	9.89	10.26	9.66	6.93	9.19
0.5	9.05	8.90	11.04	7.18	9.04
1.0	7.71	10.64	9.96	7.19	8.88
2.0	10.12	10.56	11.37	6.76	9.70
3.0	7.75	10.61	11.41	8.10	9.47
Mean	8.90	10.20	10.69	7.23	

Key: LSD (0.05) for variety = 0.82; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2levels =NS

c. Plant height at 6 weeks after planting.

H_2O_2 Level	Variety				Mean
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	16.00	16.73	13.64	10.95	14.33
0.5	15.21	15.33	14.68	10.63	13.96
1.0	15.04	17.75	13.92	12.07	14.69
2.0	17.25	16.57	14.63	10.47	14.73
3.0	13.06	16.90	14.48	14.43	14.72
Mean	15.31	16.66	14.27	11.71	

Key: LSD (0.05) for variety = 1.41; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2levels =NS

d. Plant height at 8 weeks after planting.

H_2O_2 Level	Variety				Mean
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	18.57	18.45	17.19	14.03	17.06
0.5	17.61	19.52	20.90	13.68	17.93
1.0	16.76	20.93	18.98	14.85	17.88
2.0	19.48	20.35	19.88	12.73	18.11
3.0	15.07	21.11	19.84	16.83	18.21
Mean	17.50	20.07	19.36	14.43	

Key: LSD (0.05) for variety = 2.76; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2levels =1.92

e. Plant height at 10 weeks after planting.

H_2O_2 Level	Variety				Mean
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	20.43	20.27	20.31	15.47	19.12
0.5	19.67	20.80	20.83	15.28	19.14
1.0	18.86	21.99	20.41	16.51	19.44
2.0	21.68	21.46	21.31	16.06	20.12
3.0	17.30	21.56	21.31	18.53	19.67
Mean	19.59	21.21	20.83	16.37	

Key: LSD (0.05) for variety = 1.48; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2levels =NS

Table 4.Number of leaves of groundnut varieties whose seeds were treated with H_2O_2 before planting.

a. Number of leaves at 2 weeks after planting.

H_2O_2 Level	Variety				Mean
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	12.62	12.27	6.68	6.20	9.44
0.5	11.97	11.45	8.03	8.93	10.10
1.0	12.77	11.95	6.83	9.47	10.25
2.0	10.10	13.00	9.03	8.93	10.27
3.0	11.36	11.82	6.90	9.77	9.96
Mean	11.76	12.10	7.50	8.66	

Key: LSD (0.05) for variety = 1.27; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2 levels =NS

b. N umber of leaves at 4 weeks after planting.

H_2O_2 Level	Variety				Mean
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	24.39	24.12	20.33	20.50	22.34
0.5	23.47	24.93	19.70	23.60	22.92
1.0	26.32	28.80	18.50	22.93	24.14
2.0	24.07	23.93	20.78	19.55	22.08
3.0	29.05	29.20	20.61	24.90	25.94
Mean	25.46	26.20	19.98	22.30	

Key: LSD (0.05) for variety =3.04; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2levels =NS

c. Number of leaves at 6 weeks after planting.

H_2O_2 Level	Variety				Mean
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	39.87	38.51	25.68	33.67	34.43
0.5	33.70	38.00	24.47	38.80	33.74
1.0	33.75	44.45	26.58	38.33	35.78
2.0	38.08	39.64	28.20	33.33	34.81
3.0	35.40	43.87	28.33	48.60	39.05
Mean	36.16	40.90	26.65	38.55	

Key: LSD (0.05) for variety = 4.83; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2levels =NS

Table 5.Number of days to 50% flowering in groundnut cultivars treated with H_2O_2.

H_2O_2 Level	**Variety**				**Mean**
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	**Mean**
0	24.80	26.80	30.60	29.60	27.95
0.5	23.00	27.20	30.40	29.20	27.45
1.0	24.80	27.60	30.40	28.00	27.70
2.0	24.80	26.80	30.00	28.00	27.60
3.0	24.00	26.80	30.00	29.20	27.50
Mean	24.28	27.04	30.28	28.96	

Key: LSD (0.05) for variety = 0.73; LSD forH_2O_2 levels = NS; LSD for variety x H_2O_2levels =NS

Table 6. Yield characteristics of groundnut varieties treated with H_2O_2before planting.

a. Number of pods per plant.

H_2O_2 Level	**Variety**				**Mean**
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	6.43	5.17	5.47	4.30	5.34
0.5	7.34	5.25	3.16	5.07	5.20
1.0	6.30	7.03	3.44	5.43	5.55
2.0	7.93	4.72	4.33	4.50	5.37
3.0	6.43	5.00	5.93	4.80	5.54
Mean	6.89	5.43	4.47	4.82	

Key: LSD (0.05) for variety = 0.91; LSD for H_2O_2levels = NS; LSD for variety x H_2O_2levels =Ns

b. Weight of pods

H_2O_2 Level	**Variety**				**Mean**
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	7.31	4.48	4.71	5.44	5.49
0.5	6.15	4.69	3.30	6.03	5.04
1.0	7.99	8.28	3.18	6.48	6.48
2.0	9.62	3.97	3.91	5.61	5.78
3.0	8.65	4.99	4.87	6.23	6.19
Mean	7.95	5.28	3.99	5.96	

Key: LSD (0.05) for variety = 1.51; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2levels =NS

c. Shelling percentage.

H_2O_2 Level	**Variety**				**Mean**
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	75.26	74.03	68.42	74.69	73.10
0.5	75.09	71.73	67.36	75.85	72.51
1.0	72.65	76.01	66.98	75.28	72.73
2.0	74.94	73.12	66.31	74.82	72.30
3.0	72.69	72.90	63.46	77.60	71.66
Mean	74.12	73.56	66.51	75.65	

Key: LSD (0.05) for variety = 2.07; LSD for H_2O_2 levels = NS; LSD for variety xH_2O_2 levels =NS

d. Seed yield per bag

H_2O_2 Level	**Variety**				**Mean**
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	5.48	3.31	3.21	3.92	3.98
0.5	4.66	3.48	2.24	4.62	3w.75
1.0	5.78	6.31	2.16	4.83	4.77
2.0	7.23	2.88	2.59	4.19	4.22
3.0	6.25	3.64	3.12	4.80	4.45
Mean	5.88	3.92	2.66	4.47	

Key: LSD (0.05) for variety = 1.10; LSD for H_2O_2 levels = NS; LSD for variety x H_2O_2levels =NS

e. Weight of 100 seeds

H_2O_2 Level	**Variety**				**Mean**
	Ms 54-76	ICGV-Sm-42	RmP 12	Samnut 21	
0	48.6	44.4	41.0	52.0	46.5
0.5	40.0	40.4	46.4	48.4	43.8
1.0	60.4	50.2	44.6	46.6	50.5
2.0	52.6	43.4	44.6	55.6	49.1
3.0	54.0	48.0	39.2	53.6	48.7
Mean	51.1	45.3	43.2	51.2	

Key: LSD (0.05) for variety = 0.32; LSD for H_2O_2 levels = 0.32; LSD for variety x H_2O_2levels =0.68

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