

COMBINED EFFECT OF GIBBERELIC ACID AND AGROLYZER ON THE INDUCTION OF FLOWERING, FRUITING AND SEED PRODUCTION OF SOME YAM CULTIVARS.

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Abstract

A two year experiment was conducted at National Horticultural Research Institute (NIHORT) Sub-Station Okigwe in Imo State, Nigeria in the year 2008 and 2009 to investigate the influence of micronutrient (Agrolyzer) and Growth hormone (Gibberellic acid) on the reproductive characteristics of two yam cultivars, *Obiaturugo* and *Nwaopoko* (where *Obiaturugo* represents flowering variety and *Nwaopoko* non-flowering respectively). The main effect of the treatment, variety, *Agrolyzer* and *Gibberellic acid* showed that variety and *Gibberellic acid* had significant difference ($p < 0.05$) effect on the number of pistillate flowers produced only in the second season. However, *Agrolyzer* alone did not give any significant difference on both the flowering and non-flowering variety at any level. The main effect of the treatment on the number of capsules produced showed significant difference ($P < 0.05$) only at different levels of *Agrolyzer*. While seed production increased with increased level of *GA*₃. Variety, *Agrolyzer* and *Gibberellic acid* interaction was also significant in the first year. The combination of zero *Ag* & 2500 ppm produced (82.00) capsule ($P < 0.05$) against (13.00) capsules produced by *Obiaturugo*, while in the second year a weak significant difference was observed at 30g

agrolyzer and 2500 ppm *GA*₃. This result indicates that combination of *Agrolyzer* and *GA*₃ is capable of inducing flower, fruiting and seed production potential in *Nwaopoko* (non-flowering yam variety) than *Obiaturugo* (flowering yam variety), and that 2500 ppm *GA*₃ level of *Gibberellic acid* is more effective in flower induction.

Key words: Genetic improvement, flower induction, Variety, *Agrolyzer*, *Gibberellic acid*, pistillate, staminate and ppm (parts per million)

INTRODUCTION

Genetic improvement of yam has recorded little progress due to inconsistency and sparse flowering and fruiting. Some cultivars of yam such as *Obiaturugo* in the genus *Disocoria rotundata* naturally flowers, fruits and produce seeds, while some others like *Nwaopoko* do not. The inability of flowering and fruiting in these varieties has imposed serious limitation in carrying out genetic improvement on them and in using them as breeding stocks in yam improvement scheme (Sadik, 1975a; Otoo et al, 1987; Orkwor and Ekanayake, 1997; Abraham et al 1986) and as a result reproduced vegetatively. (Martin (1966); Purseglove, 1974).

Materials and Methods:

To improve on some useful traits in these non-flowering varieties, there is need to induce flowering, fruiting and seed production. Growth hormone (Gibberellic acid), edaphic and micro-nutrient used singly, or in combination have shown to induce flowering and fruiting in some root and tuber crops (Stevenson and Ard Akain 1972; Bia and Jos 1986; Onekpise *et al*, 1999, Mbanaso *et al* (2006). Mbanaso *et al* (2007) also reported the same responses in Ariods .Martin(1966) in his work on the micro-nutrient in agriculture reported increased flowering and fruiting in tree crops, legumes, cereals and root and tuber crops with increase micro-nutrient. Research on tuber and tuberous root crops such as yam (*Dioscorea spp*) and potato (*Solanum tuberosum* L.) were focused on the effect of *Gibberellic acid* and photo periods on the development of the main shoot and new tubers. Yoshida (1999), Alhassan, and Mantell (1994) and Mbanaso *et al* (1998) showed that the combination of photoperiod, temperature and initial tuber weight was greater than single factor alone. Therefore, the interaction effect of variety, plant growth regulator and micronutrient on the flowing, fruiting and seed production of white yam was investigated.

The objective of this work was to investigate the combining effect of variety, plant growth regulator (*Gibberellic acid*) and micronutrient (*Agrolyzer*) on the flowering, fruiting and seed production of yam.

Study Area:

The experiment was carried out at the National Horticultural Research Institute (NIHORT) Mbato Okigwe Sub-station in Imo State in the South eastern Nigeria situated on lat 5^{033'N} long 7^{023'} E Plateau and on a high altitude of 130meters (GPS) above sea level. It is characterized by a mean relative humidity of 78% which is high all the year round. Has a mean annual rainfall of 2048mm and mean annual temperature which varies between 27⁰c and 27⁰c. The physical and chemical properties of the study site is as shown in the table below.

Table 1.

Physical and chemical properties of the experimental site

Soil structure	percentage	1sty	2ndy
sand		67.5	74.4
Silt		5.1	31.4
Clay		27.4	12.2
Texture class		Sandy soil	
Chemical properties			
Exchangeable bases			0.08
Ph(in water)			5.205
Exchangeable bases	(mo.p)mg/kg		31
Organic			0.13
Carbon			0.21
Calcium			3.2
Magnesium			1.6
Sodium			0.34
Nitrogen			7
Potassium			0.193

Field of Study:

The experiment was a 2x2x3 factorial arranged in a complete randomized block design with two replications. The treatment used was two yam varieties *Obiaturugo* and *Nwopoko* (representing flowering and non-flowering varieties respectively). *Agrolyzer* (micro-nutrient brand) at (0, 20, 30 g/ha) and *Gibberellic acid* (plant growth hormone) at (0, 1000 and 25000 ppm) ha. Five hundred grams (500g) of white yam tubers

(*Dioscorea rotundata* Poir) of each variety were planted at a spacing of 1m x 1m apart. Data were collected on the reproductive parameters such as: Number of flowers, number of capsules and number of seeds produced.

Data analysis:

Data collected: Number of flowers, number of capsules and number of seeds produced were subjected to statistical analysis using SAS (1999) Computer Application packages. Significant mean score were separated using the method of least significant difference at 5% level of probability.

Results and Discussion

The two seasons main effect of the treatment: variety, Agrolzyer and Gibberellic acid on the staminate, pistillate flowers and capsules showed that variety and Gibberellic acid had significant ($p < 0.05$) effect on the number of pistillate flowers produced only in the second season. *Nwaopoko* variety produced significantly higher pistillate flowers (0.56) compared to *Obiaoturugo* (0.16). Also 2500 ppm of *Gibberellic* acid produced significantly ($p < 0.05$) more pistillate flowers (0.58) as against 1000 ppm level with (0.17) (Table3). However, *Agrolzyer* did not give any significant difference on both the flowering and non-flowering variety at any level (Table2).

The interaction effect of variety: *Agrolzyer* and *Gibberellic* acid on the two varieties (*Obiaoturugo* and *Nwaopoko*) showed no significant difference ($P < 0.05$) in the number of pistillate flowers produced. Numerically

International Journal of Agriculture Management and Technology more staminate flowers 3.00 were obtained at the interaction of *Obiaoturugo*, 20g of *Agrolzyer* and 0 ppm of *Gibberellic* than other combinations. While *Nwaopoko*, 30g of *Agrolzyer* and 1000ppm of *Gibberellic* acid gave more pistillate flower (2.0) as shown in Table4.

The main effect of the treatments on the number of capsules produced by (*Nwaopoko*) (Table2) showed significant difference ($P < 0.05$) only at level difference. *Agrolzyer* gave the higher capsule number (10.50) than *Obiaoturugo* in 2008. *Obiaoturugo* variety out-yielded *Nwaopoko* variety (3.22; 3.06) in 2009. Zero *Agrolzyer* gave significantly higher capsule number (13.70) than other levels in 2008, while in 2009 30g *Agrolzyer* gave the highest capsule number (8, 17). *Gibberellic* acid at 2500ppm gave the highest capsule number (8.50) in 2008 against (3.17) in 2009. 1000ppm of *Gibberellic* acid gave the highest capsule number (4.83) in 2008 compared to 0.00 obtained in 2009.

More so the effect of the three treatments on seed production showed that *Nwaopoko* variety gave more number of seeds (4.83) than *Obiaoturugo* (3.72). 30g *Agrolzyer* gave the highest seed number (9.85) compared to 0g *Agrolzyer* (0.00) and (3.00) of 20g *Agrolzyer*. 2500ppm *Gibberellic* acid out yielded 1000ppm level with (7.03) compared with (1.83) and (4.08 respectively). It is worthy to note that seed production increases with increased level of *Gibberellic* acid.

The interaction effect of variety, *Agrolzyer* and *Gibberellic* acid on the number of

capsules produced (Table 3) showed that the combination of *Nwaopoko*, 0g *Agrolyzer* and 2500 p.m. *Gibberellic acid* yielded (82,00) capsules which significantly differ from other combinations in 2008, whereas in 2009 the highest capsule number (13.00) although not significantly different from other combinations was produced. In 2009 the highest capsule number (13.00) although not significant ($P < 0.05$) was obtained from both *Nwaopoko* and *Obiaoturugo* in combination with 30g *Agrolyzer* and 2500 ppm *Gibberellic acid*. *Nwaopoko*, 30g *Agrolyzer*, and 2500 ppm *Gibberellic acid* produced more seeds (23.50) than *Obiaoturugo* variety (18.00).

The results of Tables 1-3 showed that micronutrient in combination with growth hormone (*Gibberellic acid*) is capable of inducing flowering, fruit formation and seed production potential in no flowering variety (*Nwaopoko*) than flowering variety (*Obiaoturugo*). This result is in line with Mbanaso et al (2007) result on aroids. Again analysis showed that seed production by *Nwaopoko* increases with increased level of

The interaction effect of variety, *Agrolyzer* and *Gibberellic acid* on the two varieties (*Obiaoturugo* and *Nwaopoko*) showed no significant difference ($P < 0.05$) in the number of *staminate* and *pistillate* flowers produced. Numerically more *staminate* flowers (3.00) were obtained at the interaction of *Obiaoturugo*, 20g of *Agrolyzer* and 0 ppm of *Gibberellic acid* than other combination. While *Nwaopoko*, 30g *Agrolyzer* and 1000 ppm of *Gibberellic acid* gave more female flower (2.00) as shown in Table 4.

Conclusion

The successful production of flower and seed from the *Nwapoko* variety, which does not flower naturally, is an indication that the combination of *Agrolyzer* and *Gibberellic acid* is effective for flower induction and yield improvement in Nigeria.

Table 1: Main Effect of variety, on reproductive parameters of Obiaoturugo

Treatment		S	P	CN	SN
Variety					
<i>Obiaoturugo</i>	1 st	5.67	1.22	1.22	0.00
	2 nd	0.16	0.17	0.11	-
<i>Nwopoko</i>	1 st	5.89	0.89	0.67	10.50
	2 nd	0.33	0.34	0.56	-
LSD	1 st	0.37	1.09	0.60	1.9
	2 nd	0.42	0.29	19.16	-

S=Staminate, p=Pistillate, CN=capsule number, SN =seed number

Table 2: Main Effect of agrolyzer on reproductive parameters of Obiaoturugo (flowering) and Nwopoko (non-flowering) yams

Treatment		S	P	CN	SN
Agrolyzer (g)					
0g	1 st	0.83	0.58	0.00	0.00
	2 nd	0.25	0.25	13.29	-
20	1st	1.08	1.08	1.25	3.00
	2 nd	0.17	0.42	0.75	-
30	1st	1.25	1.17	8.17	9.83
	2 nd	0.33	0.33	4.08	-
LSD		1.34	0.73	6.76	8.51
		0.52	0.35	24.02	

S=Staminate, p=Pistillate, CN=capsule number, SN =seed number

Table3: Main Effect of Gibberellic acid on reproductive parameters of Obiaorutugo (flowering) and Nwopoko (non-flowering) yams

Treatment		S	P	CN	SN
Gibberellic (ppm)					
0	1 st	5.75	1.50	1.17	
	2 nd	0.00	0.00	0.25	0.00
1000	1st	5.83	1.17	1.92	0.00
	2 nd	0.17	0.17	0.17	-
2500	1st	5.75	0.50	0.75	18.50
	2 nd	0.58	0.58	0.58	-
LSD		0.45	1.34	0.73	24.02
		0.52	0.52	0.52	-

S=Staminate, p=Pistillate, CN=capsule number, SN =seed number

Table 4: The interaction effect of Variety, Agrolyzerand Gibberellic Acid on the flowering and capsule production white.

Interaction Effect of Variety	Staminate		Pistillate		Capsule number	
	1 st yr	2 nd yr	2 st yr	1 nd yr	2 st yr	1 nd yr
F+0Ag0GA ₃	0.00	1.00	0.00	0.05	0.00	1.00
F+0Ag+1000GA ₃	0.50	2.50	0.00	1.00	0.00	0.00
F+0Ag+2500GA ₃	0.50	0.50	0.00	1.50	0.00	0.00
F+20Ag+0GA ₃	0.00	3.00	0.00	2.00	0.00	1.50
F+20Ag+1000GA ₃	0.00	2.50	0.00	0.50	0.00	2.00
F+20Ag+2500GA ₃	0.00	0.00	0.00	0.50	0.00	3.50
F+30Ag+0GA ₃	0.00	2.00	0.00	2.00	0.00	0.00
F+30Ag+1000GA ₃	0.00	0.50	0.00	2.00	0.00	0.00
F+30Ag+2500GA ₃	16.50	0.00	1.00	0.00	16.00	13.00
N+0Ag+0GA ₃	0.50	1.00	0.50	2.00	0.00	0.00
N+0Ag+1000GA ₃	0.50	0.50	0.50	2.00	0.00	0.00
N+0Ag+2500GA ₃	0.50	0.00	0.50	0.00	82.00	0.00
N+20Ag+0GA ₃	0.00	0.00	1.00	0.05	0.00	0.00
N+20Ag+1000GA ₃	0.00	1.00	1.50	1.50	0.00	0.00
N+20Ag+2500GA ₃	1.00	0.00	0.00	0.05	4.00	2.50
N+30Ag+0GA ₃	0.00	2.00	0.00	1.50	0.00	3.50
N+30Ag+1000GA ₃	0.00	0.00	0.50	2.00	0.00	3.50
N+30Ag+2500GA ₃	1.50	0.00	0.50	1.00	8.00	13.00
LSD	3.26	1.34	0.85	1.79	58.84	7.85

N-Non-flowering, F-Flowering, AG-Agrolzyer, GA₃- Gibberellic acid

Source: Field Data 2008/2009

REFERENCES

- Abraham, K.Nair, S.G. Sreekumari M.I and Unnikrishnan, M. 1986. Seed set and seedling variation in greater yam (*Dioscorea alata* L.) *Euphytica* 35(2): 337-343.
- Akoroda, M. O. (1983a). Floral biology and hand pollination of white yam. *Euphytica* 32: 831-838.
- Akoroda, M. O. (1985b). Seed production in White Yam Seed Science and Technology 13:57-581.
- Alhassan, A. Y. and Mantell, S. H. (1994). Manipulation of Cultural Factors to Increase Micro tubers size and frequency in shoot culture of food yam, *Dioscorea alata* L. cv. Oriental Lisbon. In: *Proceedings of the Ninth Symposium of the International Society of Tropical Root Crops*. F. Ofori and S.K. Hahn, eds. 20-26 October 1991, Accra, Ghana.
- Anolin, R. (1985). Different reactions of yam (*Dioscorea* Spp) to in vitro node culture in Reference to the cultivar. Abstract in the Symposium of International Society for Tropical Root Crops.
- Asiedu, R (1997). Towards a development strategy for yams, International society for Tropical Root Crops (ISTRC) (Newsletter No 24; 24; 305-317.
- Bia, K. V. and Jos, (1986) Female fertility and seed set in *Dioscorea alata* L. *Tropical Agriculture (Trinidad)* (63 (1).
- Bai, K.V. and I.J. Ekanayake. (1998) Taxonomy, Morphology and floral biology in food yams Advances in research. Asiedu, R. Orkwor, G.O. and I.J. Ekanayank (eds) IITA Ibadan and NRCRI, Umudike, Nigeria 13-39
- Martin F. N. (1966). Sex ratio and sex determination in *Dioscorea*. *Journal of hereditary* 57: pp95-99.
- Igwilo, N.H. and Mbanaso, E.N.A. (1984). Effect of gibberellic acid alcohol on the sprouting and storage of yams. NRCRI Umudike, Annual Report (1984). Nigeria. pp. 109-111
- Igwe, C.A. Ekebosi, G.O, Zarei, M and Stahn, K (2007). Mineralogy and Paedogenesis in soil chronosequence on a flood plain, Eastern Nigeria, *Agro Science, Food, Environment and Extension*; Vol.6 Number2; pp1-15.
- Mbanaso E.N.A and L.S.O Ene. (1998). Aspects of biotechnology for the improvement of cassava (*Manihot esculenta*) and yams (*Dioscorea* spp.) at the National Root Crops Research Institute, Umudike. In: *The use of biotechnology for the improvement of cassava, yams and plantain in Africa*. IITA Meeting report series 1988/2. IITA, Ibadan, Nigeria. pp. 24-28
- Mbanaso E.N.A; Nwanchukwu, E.C, Egesi C.N., Chukwu L. I; Nwoko, S.U and Ogbonye, P. (2006) Induction of flowering and fruiting in Cocoyam using various concentration of Gibberellic Acid (GA₃) NRCRI Annual Report, (2005) pp 153-156.
- Yoshida 1999; Cultivars that flower naturally and the period of flowering, flowering frequency and are dependent on time of planting (IITA 1980) Edem 1975) quality and size of planting materials (Waitt (1964) Seasonality effect was reprinted by (Sendike and Okereke 1975b).
- Onokpise, O. U., Wutoh, J. G., Ndzana, X., Tambong, J.T., Meboka, M.M., Sama, A. E., Nyochembeng, L., Aguegia, A., Nzietchueng, S., Wilson, J.G., and Burns, M. (1999), Evaluation of marabou, Cocoyam Germplasm in Cameroon; In "Perspective on New Crop and new uses. (Ed) J. Janick. ASHS press, Alexandria VApp 394-396
- Orkwor and Ekanayake (1997), Hindrance of flowering improvement as a result of flowering habit
- Orkwor, G.C and I.J. Ekanayaka, (1998). Growth and development in food yams. *Advances*

in reseach, op cite;39-63.

Otoo,JA.D.S.OOsiru, S. Y Ng and S.K.Hahn (1987).Improved technology for seed yam production. IITA Ibadan Nigeria 56

Purseglove. J. W (1977) Tropical Crops and Monocotyledons.2nd impression Longman.

Sadik,S and O.U Okereke, (1975a) Flowering, pollen grain germination, fruiting, seed germination and seedling development of white yam, *Dioscorea rotunda* Poir, *Annals of Botany* 39;592-604.Stevenson,F.Z and Ard Akain, M.sc. In micronutrient in Agriculture (ede jj, Mortvedt,p.p. Giordaro and N.C Lindsay (1972)soil sic. Soc AM Madison wis. Pp. 79-114.