Assessment of planting technique and planting density on insects damage, defoliation and pod-rot of groundnut

Ihejirika GO*, Ibeawuchi II, Ogbedeh KO

Department of Crop Science and Technology, Federal University of Technology, PMB 1526*, Owerri, Nigeria*

Received March 4, 2008

Abstract

Test plant varied in strength and persistence to damages caused by insects, defoliation and pod-rot due to variation in planting techniques and plant densities. Investigation revealed that a plant technique was statistically significant on defoliation 144.3 and 57.58 in 2002 and 2003 respectively as well as insect damage 5.65 in 2002. However, it was not significant in pod-rot at 5% probability level. Plant density was significant on insect damage 11.94 and 10.25, defoliation 394.50% and 284.9% and pod-rot 6.50 and 2.35 in 2002 and 2003 respectively, while interaction of planting technique and density was not significant on any of the parameters investigated. Ridging recorded high insect damage 3.25 and 3.13 and defoliation 97.6% and 79.4% as well as pod-rot 2.63 and 2.31 in comparison with furrow when flat had the lowest in all these parameters in 2002 and 2003 respectively. (15 × 15) cm had the highest insect damage 3.15 and 3.67 and defoliation 80.5% and 81.2% as well as pod-rot 2.92 and 2.42 when (20 × 20) cm recorded the lowest of each of these parameters investigated in 2002 and 2003 respectively. Some trend was obtained on inter-veinal infestation, number of larvae girdle and cut off and number of holes created on leaves and pods in 2002 and 2003 respectively. [Life Science Journal. 2008; 5(2): 58 – 62] (ISSN: 1097 – 8135).

Keywords: techniques; density; insect damage; defoliation; pod-rot; groundnut

1 Introduction

Groundnut (*Arachis hypogene* L) is a very important source of vegetable oil in the world. Its seed oil is used in the manufacture of margarine, pharmaceuticals, cosmetics, lubricants and emulsions for insecticides. Summerfield and Roberts (1985) and Mupangwa and Tagwira (2001) observed that Na, Ca and Mg limit yield of groundnut. Ridges are chiefly used for root crops but in some places they are employed for the majority of crops. It may serve variety of purpose such as provision of simple means of burying grass, weeds and crop residues thus, preventing the re-growth of weeds and making use of their manual value. In areas of water-logging, ridges improve drainage, reduce soil insect pests and naturally increases yield. Vogel (1993) observed that tied ridges gave 40% increase in yield of maize over flat cultivation. As the soil and its organic matter are held together giving greater reserves of water whereas those on flat were wateressed. Same was observed by Honisch (1994) as pulverised nature of the soil, expose some soil insect pest to birds and other predators while some die due to hash sunshine or weather condition and reduction in these insects result to reduction in their attack on the crops resulting to yield increase when compared to those planted on flat or furrow.

According to global convention on biological diversity (BD, 2003), plant pests include any species, strain or biotype of plant animal or pathogenic agent injurious to plant or plant product. Plants highest damage is obtained from insect pests among other pests. Teyproduce inter-veinal holes in the leaves of young plants, larvae of foliage beetles (*Ootheca mutabolis*), feed on the roots of groundnut plants causing premature senescence. Also, larvae of Cutworms mostly of the genera *Agrotis* and *Spodoptera*, girdle and cut off plants at soil level leaving cavity that cause plants to wilt and die. Insect pests are important factor in the infliction of injury on crops (crop damage) and also they act as vectors of plant pathogens. Insect pests among others cause considerable loss to groundnut farm-

*Corresponding author. Email: ihegab@yahoo.com

ers. Adult beetles and larvae, feed on the pods and leaves causing numerous small holes (NRI, 1996). Injuries delay plant development, photosynthetic activities and reduce yield.

2 Materials and Methods

The research was conducted in the School of Agriculture and Agriculture Technology Research Plot of Federal University of Technology, Owerri using groundnut variety P1274/191 in 2002 and 2003 respectively, located at 5º29' N and 7º02' E. Mean annual rainfall is 1800 mm which span early March to October with temperature range of 24 – 27 ºC during the grouping season. Soil samples were collected randomly at 0 – 15 cm and 15 – 30 cm deep respectively, for analysis to determine the nutrient and acidic status of the soil.

Three planting techniques were investigated upon which include planting on flat, ridge and furrows, on four planting densities of 444444, 250000, 111111 and 160000 plants/ha respectively, giving (15 × 15) cm, (20 × 20) cm, (25 × 25) cm and (30 × 30) cm respectively, with planting technique on the main plot while plant density occurred as sub-plot at 4 replications. This gives 3 × 4 = 12 combinations at 4 rep = 3 × 4 × 4 = 48 plots, on plots measuring 2 m × 1 m with 0.4 m as main plot gap and 0.2 m as sub-plot gap in 2002 and 2003 respectively. Data was collected on insect damage, defoliation and pod-rot of groundnut.

2.1 Insect damage

Number of perforated leaves were counted one after the other and expressed as a percentage of the total leaves formed. Also presence of larvae or its attack on the leaves, stem or leaf as shown by their girdles and cut off or cavities left below ground were counted. At harvest, damaged pods were counted and expressed as percentage of the total pods formed and recorded per treatment level.

Percentage incidence was calculated using the following formula: Percentage = $(x - n) / x \times 100\%$.

Where x = total number of plants examined per location and n = total number of plants without exit holes.

2.2 Defoliation

The percentage defoliation was determined by counting abscised and retained leaflets while pod-rot was obtain by counting the number of rotten pods at harvest and expressed as percentage of the total pods formed and recorded per treatment level.

The micro-organism responsible for the rotten pods was identified. Rotten pods were taken to the laboratory in sterile polyethylene bags, sterilized with ethanol (80%) and left for 5 minutes. It was then washed in tap water and rinsed in distilled water 5 mm tissue of rotten groundnut pods as well as seeds were plated on Potato Dextrose Agar (PDA). Pure cultures were obtained by sub-culturing and observed using a high powered microscope. It was later identified using the method adopted by Barrett and Hunter (1999).

2.3 Statistical analysis

Also analysis of variance (ANOVA) was conducted for means of variables. Significant different variables were separated using Fischer's Least Significant Difference (P = 0.05) and according to Statistical Analysis System (SAS, 1999).

3 Results

Investigation carried out on the soil analysis revealed that pH was 4.7 and 4.9, nitrogen 0.40% and 0.42%, phosphorus 7.8 ppm and 7.89 ppm, exchangeable calcium 0.02 meg/100 soil and 0.03 meg/100g soil in 2002 and 2003 respectively. Plant technique was significant on insect damage 5.65, in 2002, defoliation 144.3 and 57.58 in 2002 and 2003 respectively at 5% probability level, but not significant on pod-rot 4.52 and 2.77 in 2002 and 2003 respectively. Plant density was significant on insect damage 11.94 and 10.25 and defoliation 394.5 and 284.9 in 2002 and 2003 respectively. However, interaction of planting techniques and plant density was not significant in all the parameters and seasons investigated at 5% probability level (Table 1).

Groundnut planted on ridge recorded high insect damage 3.25 and 3.13 in comparison with furrows 2.69 and 2.89 when those planted on flat 2.08 amd 2.06 were lowest in 2002 and 2003 respectively. Also groundnut planted on ridge recorded high defoliation 79.65% and 79.40% followed by furrow while those planted on flat was the lowest. Same trend was obtained on pod-rot with ridge 2.63 and 2.31 as highest, followed by furrow when flat 1.56 and 1.62 was lowest in 2002 and 2003 respectively. Plant density (20 × 20) cm in 2002 and 2003 had lowest insect damage 1.33 and 1.42 when (15 × 15) cm had highest 3.75 and 3.67. On defoliation, (20 × 20) cm also recorded lowest 68.17% and 70.50% when (15 × 15) cm also had highest 80.50% and 81.20% as well as pod rot 2.92 and 2.42 and 20 × 20 cm recorded the lowest rotten pods 1.17 and 1.33 in 2002 and 2003 respectively (Table 2).

Investigation on insect percentage infestation, number of larvae on leaves and number of holes created by insects, revealed that ridge was significantly high in all

Table 1. Analysis of variance of insect damage, defoliation and pod rot of groundnut in 2002 and 2003

Sources	Insect damage (%)		Defoliation (%)		Pod rot (%)	
	2002	2003	2002	2003	2002	2003
Mean square	2.20*	1.71*	61.9*	43.43	1.38	0.57
Mean	2.67	2.63	76.7	77.7	2.08	1.85
Rep.	0.67	0.53	8.97	10.89	0.72	0.47
Tech.	5.65*	4.56	144.3*	57.58*	4.52	2.77
Rep × tech.	0.97	10.25	394.5	284.9	6.50	2.35
Dens	11.94*	10.25*	394.5*	284.9*	6.50*	2.35
Tech × Dens.	1.09	0.81	14.8	1.47	0.35	0.02
Rep × Dens.	0.24	0.18	17.6	19.04	0.37	0.17

*: Statistically significant at 5% probability level.

Table 2. Effects of plant technique and plant density on insect damage, defoliation and pod rot of groundnut in 2002 and 2003

	Insect damage (%)		Defoliation (%)		Pod rot (%)	
	2002	2003	2002	2003	2002	2003
Plant technique						
Flat	2.08	2.06	73.63	75.60	1.56	1.62
Ridge	3.25	3.13	79.65	79.40	2.63	2.31
Furrow	2.69	2.89	76.88	78.00	2.06	1.75
$LSD_{0.05}$	0.462	0.650	1.733	1.635	0.451	0.412
Plant density						
15 × 15 (cm)	3.75	3.67	80.50	81.20	2.92	2.42
20 × 20 (cm)	1.33	1.42	68.17	70.5	1.17	1.33
25 × 25 (cm)	2.75	2.67	79.00	78.80	2.33	1.83
30 × 30 (cm)	2.83	2.75	79.17	80.20	1.92	1.83
$LSD_{0.05}$	0.533	0.751	2.001	1.887	0.625	0.476

these parameters when flat was lowest in 2002 and 2003 respectively. 20 × 20 cm recorded lowest percentage infestation 60.50%, 55.10%, number of larvae 0.06, 0.10 and number of hole 0.02, 0.04 when 15 × 15 cm had highest insect infestation 80.06%, 70.70% as well as number of larvae on leaves 0.31, 0.30 and 0.03, 0.01 number of holes in 2002 and 2003 respectively. (20 × 20) cm had the lowest insect infestation, number of larvae and number of all these parameters in 2002 and 2003 respectively. (20 × 20) cm and (25 × 25) cm records were not different in these parameters. Also the two extreme plant densities investigated, which were (15 × 15) cm and (30 × 30) cm, were not different on insect infestation, number of larvae on leaf whorl and number of holes in 2002 and 2003 respectively (Table 3). The micro-organism identified with rotten pods were *Rhizotonia solani*, *Fusarium xysporum*, *Aspergillns flarus* and *Phytophthora spp* with *Rhizotonia solani* recording highest followed by *Asperigillus flavus*. The insects identified were Foliage beetles *Ootheca mutabilis* of the family *Curculionidae* and of the order *Coloeptera* as well as Cutworms. The cutworms, which are larvae of moths, are of the genera of *Agrotis* and *Spodoptera* and they are of the order *Lepidoptera*.

4 Discussion

The relatively acidic nature of the site, with low level of nitrogen, phosphorus and potassium is common to tropical Ultisols which are textured as a result of high rainfall, leaching, volalisation and fixation of nutrients. The significant difference recorded by planting technique on insect damage and defoliation, may be attributed to the fact that planting technique had influence on insect damage and defoliation as well as plant density. The high reduction of insect damage by groundnut planted on flat in comparison with furrow when ridge had the highest may be attributed to the fine filth of flat, proper organic matter and soil

Table 3. Effects of planting technique and plant density on % inter-veinal infestation, number of Girdles and cut off and number of holes per plant in 2002 and 2003

	% inter-veinal infestation		No. of Girdles and cut off		No. of holes	
	2002	2003	2002	2003	2002	2003
Plant technique						
Flat	60.80[a]	54.20[a]	0.08[a]	0.10[a]	0.03[a]	0.01[a]
Ridge	85.26[b]	80.06[b]	0.32[b]	0.22[b]	0.33[b]	0.36[b]
Furrow	76.54b	72.20b	0.20b	0.26	0.28b	0.30b
Plant density						
15 × 15	80.06[b]	70.70[b]	0.31[b]	0.30[b]	0.03[b]	0.01[b]
20 × 20	60.50[a]	55.10[a]	0.06[a]	0.10[a]	0.02[a]	0.04[a]
25 × 25	70.45[a]	60.00[a]	0.18[b]	0.23[b]	0.08[a]	0.10[a]
30 × 30	77.23[b]	70.42[b]	0.25[b]	0.25[b]	0.30[b]	0.38[b]

Treatments with same superscript within the same column are not different from each other according to Duncan Multiple Range Test (DMRT) at 5% probability level.

mixing, as well as low loss of soil nutrient and less water stress by those planted on flat. All these provide good root base and encourage normal biochemical processes and are factors that affect insect pest occurrence in this cropping system in agreement with Mumford and Baliddawa (1993). They also encourage healthy plant growth and less reaction to insect pest attack, as well as diseases and its vectors. This is in line with Dagg and McCartney (1968) who pointed out that plants on flat had no water stress in comparison with ridge. Water stress encourages quick reactions to insect and pathogenic attack.

Also since ridges are characterised by high erosion and leaching of available nutrients, groundnut planted on ridge were faced with water stress and nutrient deficiency situation which reduce physiological and metabolic activities of the plant. The plants became weak and were unable to with stand insect infestation, dismtegration of pod tissues (pod-rot) and defoliation. Also the large soil volume obtained by the process of ridging, expose the plants to soil borne pathogens which girdle and cut off plants at soil level below ground leaving cavity that cause the plants to wilt and die. It also made sure that greater population of insects and plant pathogens accumulate on ridges and as such increase their attacks in line with Lyons (2000).

High insect damage, inter-veinal holes, defoliation, pod-rot, larvae girdling and cut off, and number of holes on pods recorded by 444444 plants in comparison with 250000 plants/ha may be attributed to over crowded nature of this density, which resulted to high competition, exhaustion of available soil nutrient and reduction in biochemical activities and quick response to disease infection. The bush-like nature of this density provides an increasing natural shade for insect and other pathogens. This is in agreement with IITA (1974) who proposed that powdery mildew incidence increased significantly with increasing natural shade.

The lower insect infestation, defoliation and pod rot recorded by 250000 plants/ha, may be due to adequate crop interaction that favours ideal utilization of available soil nutrients for photosynthetic activities. The slow response to insect and disease attack by this density, provide healthy growth and development as well as ability to wage war against insect and pathogenic attack in the line with Anyim (2002). Microorganism associated with the disease development observed include *Aspergillus* species, *Fusarium oxysporum*, *Rhizotonia solani*, *Pensicillin spp* and *Bortryotis spp* in line with Richardson (1990). The Foliage beetles *Ootheca mutabilois* are characterised by inter-veinal holes in the leaves of young plants. The larvae feed on roots of groundnut plants causing pre-mature senescence and adults are vectors of virus. The cutworms on the other hand, girdle and cut-off plants at soil level. Below ground, damage leaves cavities that cause plants to wilt and die.

5 Conclusion

Groundnut planted on flat recorded lowest insect damage, defoliation, pod rot followed by those planted on furrow, when those planted on ridge had the highest in 2002 and 2003 respectively. Leaf infestation, number of holes (both inter-veinal holes and holes on pods) as well as larvae girdling and cut off were high on groundnut planted on ridges when those planted on flat were lowest. Micro-organism associated with the diseases observed were mostly *Aspergillus spp*, *Rhizotonia solani Penicillin spp*

and *Botroytis spp* with *Aspencillin* and *Rhizotonia* occurring highest. Also groundnut planted at 250000 plants/ha has the lowest insect and disease infestation while 444444 pants/ha had the highest in all the seasons investigated.

References

1. Anyim A. Effect of Planting Dates on the Population Dynamics of the Pod Sucking Bug Nezzare viridula L. (*Hemiptera: penatatomida*) in South Eastern Nigeria. Procc 36th Ann Conf Agriculture Society of Nigeria. 2002: 71 – 4.
2. Barnette HL, Hunter BB. Illustrated Genera of Imperfect Fungi. The American Phytopathological Society. 3rd Edn. St. Paul Minnesota, USA. 1998; 218.
3. Biological Diversity. Global Overview of the Management of Invasive Alien Species. In: Proceedings of a Workshop in Braunschweig, Germany, 2003.
4. Dagg M, McCartney JC. The agronomic efficiency of the NIAE mechanized tried – ridge system of cultivation. Expl Agric 1968; 4: 279 – 94.
5. Honisch O. Water conservation in there grain crops in the Zambezi valley. Expl Agric 1994; 10: 1 – 8.
6. International Institute of Tropical Agriculture. Annual Report 1974.
7. Lyons EE. Preliminary Survey of Invasive Species in East Africa. In: Lyons EE, Miller SE (Eds). Invasive Species in Easter Africa. Proceedings of a Workshop held at ICIPE, July 5 – 6, 1999. International Centre of Insect physiology and Ecology (ICIPE) Science Press, Nairobi, Kenya. 2000; 65 – 70.
8. Mumford JD, Baliddawa CW. Factors affecting insect pest occurrence in various cropping systems. Journal of Insect Science and Application 1993; 4: 59 – 64.
9. Mupangna W, Tagwira F. Effect of calcium, magnesium and potassium on groundnut yield in acid sandy soil of the small holder farming sector of Zimbabive. 5th Biennial Conf. African Crop Science Society Abst. P 2001; 108.
10. Natural Resources Institute. A Guide to Insect Pests of Nigeria Crops. Identification, Biology and Control. 1996; 190 – 6.
11. Richardson MJ. An Annotated List of Seed-borne Diseases. 4th Edition. The International Seed Testing Association, Zurich, Switzerland. 1990.
12. Summerfield MJ, Roberts LT. Tropical grain legumes. Economic Botan 1985; 39: 157 – 64.
13. Vogel H. Tillage effects on maize yield, rooting depth and soil water content on sandy soils in Zimbabwe. Field Crop Research 1993; 33(4): 367 – 84.