International Journal of
Life Sciences
International Peer Reviewed Open Access Refereed Journal

Int. J. of Life Sciences, 2020; 8 (1):59-69
ISSN:2320-7817(p) | 2320-964X(o)

Original Article Open Access

Interaction of phosphorus and foliar zinc on seed quality and aspergillus infection on groundnut (*Arachis hypogaea* L.) genotypes in dryland area of Tanqua Abergelle, Ethiopia

Hintsa Meresa[1]* and Yemane Tsehaye[2]

[1]Abergelle Agricultural Research Center P. O. Box 44 Abi-Adi, Ethiopia.
[2]Department of Crop and Horticultural Science, Mekelle University, Ethiopia
Email: hintsa1982@gmail.com

Manuscript details:

Received: 21.12.2019
Accepted: 18.03.2020
Published: 05.04.2020

Cite this article as:
Hintsa Meresa and Yemane Tsehaye (2020) Interaction of phosphorus and foliar zinc on seed quality and aspergillus infection on groundnut (*Arachis hypogaea* L.) genotypes in dryland area of Tanqua Abergelle, Ethiopia, *Int. J. of. Life Sciences*, Volume 8(1): 59-69.

Available online on
http://www.ijlsci.in
ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

ABSTRACT

Groundnut is an important oil and protein crop in Ethiopia. Abergelle is one of the dryland part of Ethiopia that is agro ecological potential to groundnut production. Management practice and Lake of improved varieties are a major limitation for low yield and seed quality. Due to this intervention, field experiment was implementing at Sheka Tekli, dry land area of Abergelle, in 2017/2018 cropping season to investigate the interaction effect of phosphorus with foliar zinc application on groundnut genotypes to seed yield and quality traits. The design is arranged in split plot assign with three replications. The treatments are consisted of three groundnut genotypes (ICGV00308, ICGV 91114 and sedi) including the standard check (Sedi) as main plot and four interaction (P with Zn) fertilizer level at 0kg (control), (10kgP/ha +0.50 gZn/L), (20kgP/ha + 1gZn/L,)(30kg P/ha + 1.5 gZn/L) as sub plot was used. Nutritional quality of the crop: crude protein content (%) and fat (%) and seed yield significantly affected by interaction effect of the combine fertilizer PZn and genotypes. Hence, the highest seed yield (2529kg/ha), crude protein content (37.79%) and net return (43,519.34) from (30 kgP/ha+1.5gZn/L) with standard check (sedi) variety could be conclude to high seed yield, protein quality and profitability advantage (11.1%) of groundnut production compare to the varieties without fertilization. Whereas the highest percentage of fat (43.95) was extracted from the genotype ICGV00308 with (30 kgP/ha+1.5gZn/L).The main effect of genotypes revealed significance influence on the aspergillus infection (35%) from the standard check sedi variety than the new genotypes. Using this study as a tool, further research will be conduct to increase yield of the crop.

Key words: Groundnut genotypes, Phosphorus, Foliar-spraying zinc, Seed yield, Seed quality, BCR .

INTRODUCTION

Groundnut (*Arachis hypogaea* L.), also known as peanut, earthnut, monkey-nut is a self-pollinating, indeterminate, annual herbaceous legume crop (Adinya *et al*., 2010).Groundnut is the thirteenth most important food crop of the world; fourth most important source of edible oil and the third most important source of vegetable protein (Taru *et al*., 2008). Ethiopia retains varying climatic conditions results in the cultivation of a wide range oil crops including groundnut. Groundnut was introduced to Ethiopia in the early 1920s from Eritrea to Hararghe by the Italian travelers (Daniel, 2009). Presently it accounts 13.64% of total oil seed produced and important cash income for several small-scale producers and foreign exchange earnings through export for the country (Gezahagn,2013). The estimated production area and yield of groundnut in Ethiopia in 2013/2014 cropping season were 79,947.03ha and 1,120,887.24 quintals, respectively (CSA, 2014).

Groundnut is an important oil cash crop in Tigray region, Northern Ethiopia. The region is categorized mainly as a semi-arid, drought stressed, less fertile soils due to land degradation (IFPRI, 2011). Its production in Ethiopia is compelled by several abiotic and biotic factors including moisture stress, lack of improved varieties, poor soil fertility, and diseases affecting both productivity and nutritional quality of the kernels. Among the important factors low soil fertility status, access of improved variety, poor agronomic practices are major factors affecting crop yield, nutritional quality and aspergillus infection.

Regarding the biotic factors disease problems of groundnut kernel infection caused by the toxigenic fungi *Aspergillus* and the associated aflatoxins contamination are found to be among the very critical biotic challenges in groundnut production in most groundnut growing areas of the Tigray region (Dereje, *et al*., 2012). The detected aflatoxin concentrations in groundnut samples from Tigray were ranging from 0.1 to 397.8 ppb with the average contamination of 28.7 ppm (Dereje *et al., 2012).* This level of contamination is higher than the maximum acceptable limit in the global market.

Phosphorus and zinc very important for seed yield and quality traits: these justifies the need to investigate and understand how the different groundnut genotypes will interact to the combined rates of P with foliar Zn fertilizers in the Dryland areas of the Abergelle. Due to this intervention, objective of this study was: To determine the interaction of phosphors with foliar zinc application and groundnut genotypes on seed nutritional quality and *Aspergillus infection*.

MATERIALS AND METHODS

Description of the Study Area

The study area (Tanqua Abergelle) is considered as one of the most important place for groundnut crop in Tigray Region, Northern Ethiopia. The study area lies between latitude of 13^0 14' 06" N and longitudes of 38^0 58' 50" E respectively. The great importance of agriculture to the district economy can be measured by the fact that it directly supports about 85% of the population in terms of employment and livelihood (CSA, 2013).

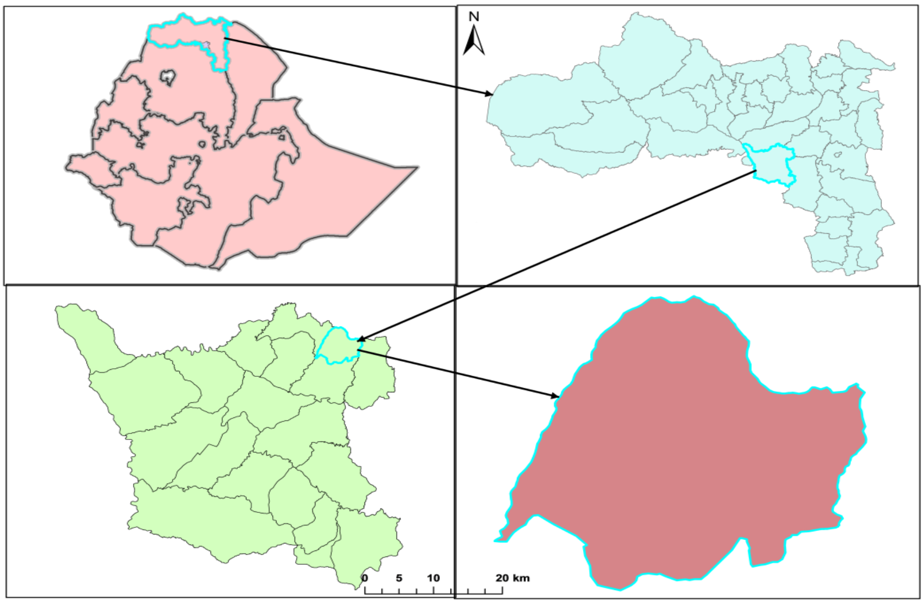

Figure 2. 1: Map of the study area

Table 2.1 Description of the genotypes used in the study

Genotypes	Status	Source	Color
ICGV00308	Advance line	ICRISAT-Mali	Light white
ICGV91114	Advance line	ICRISAT-Mali	Light white
Sedi	Released variety	Melka-Werer ARC	Light red

Materials Used

Groundnut genotypes named ICGV00308, ICGV91114 and sedi (standard check) were used as a planting material. The genotypes ICGV00308 and ICGV91114 was brought from ICRISAT-Mali, and is relatively adapted to the experimental area which experimented by mekelle university in Tigray, are shown good performance. Sedi is a standard check variety, which is found in the cultivation area widely. Triple super phosphate (TSP) and zinc are P and zinc sulphate ($ZnSO4\ 7H_2O$) was used as a source of the fertilizer respectively.

Treatments and Experimental Design

The experiment was laid out in a split plot design, Randomized Complete Block Design (RCBD) arrangement with three replications. The experiment consisted two factors; which is genotypes (ICGV00308, ICGV9111, and standard check (Sedi) and four combination of fertilizers (0, 10kg P/ha + 0.50 g Zn/L, 20kg P/ha + 1g Zn/L & 30kg P/ha + 1.5 g Zn/L were used as a main plot and sub-plot respectively. The total plot size were 3.6m^2 (1.8 mX2 m), having 45 cm distance between rows and 20 cm between plants. Jeetarwal (2013) reported that spacing between rows 40-60cm according to variety; spacing within rows 15-30 cm is appropriate for groundnut. The total number of plants per plot was forty. Only plants in the central two rows were harvest for determination of the seed yield per hectare, quality(crude protein and fat percentage) and aspergillus fungus.

Management Practice and Planting Method of the Experiment

Based on the specification of the design a field layout was prepared and each treatment was assigned randomly to each plot within a block. All rates of phosphorus fertilizer were applied at the time of planting and zinc fertilizer was applied at flowering stage at foliar. Further available agronomic practice like eartheningup weeding, hoeing and nitrogen fertilizer as starter 15kg per ha was applied uniformly to all treatments.

Soil Sampling and Analysis

Soil samples were collect from five spots from the experimental field before planting diagonally at a depth of 0-30cm, which is the estimated root depth of groundnut using an auger for the selected physicochemical properties of the soil analysis.

Aspergillus* Fungus *Infection Analysis

Seeds were collect from the experimental areas produced from the application of phosphorus and foliar zinc on the genotypes was examined for identification incidence of fungus. Twenty-five groundnut seeds per sample were sterilized by sodium hypochlorite solution for 1 minute, followed by immersion in sterile distilled water for 1 minute. Sterilized seeds were then place on freshly ready material plates (twenty five seeds per plate) and put for sixty minutes at refrigerator to kill germination. The plates were stay for 7 days at dark room to grow the fungus and 2.5 ml of sterile distilled water was used for further use.

Seed Quality Analysis

Crude Protein Determination

The amount of crude protein in the sample was determined according to AOAC (1995), by Kjeldahl method of nitrogen analysis. About 3g of sample was be poured into digestion flask containing catalyst, 1 g of mixture Na_2SO_4 mixed with anhydrous $CuSO_4$ in 10:1 and 5 mL of concentrated H_2SO_4. Digestion was carried out using digestion apparatus. The Kjeldahl flask was heated to temperature of 350°C on digestion apparatus using heater and digestion was continued until the digest were clear. The acid digest was allowed to cool room temperature. Distillation was performed by adding 30 mL of distilled water, 25mL 40% NaOH to Kjeldahl flask and connecting it to distillation apparatus whose out let tube is immersed in 25 mL of 4% boric acid solution. The distillate (150 mL) was collect and titrated by standard acid (0.1N HCl).

$$N = \left(\frac{V_{HCl} \times N_{HCl} \times 14}{M} \right) \times 100$$

Proportion of Fat Determination

The crude fat analysis was determined by soxhlet extraction method according to AOAC (1995). Sample (about 2g) was weighed and added into a thimble. The thimble with sample were placed in 50mL beaker and dried in an oven for 2 hour at 110°C. A 150-250 mL dried beaker was weighed and rinsed several times with petroleum ether. The samples contained in the thimble were extracted with petroleum ether in a soxhlet extraction apparatus for 6-8 hours. After the extractions were complete, the extracted fat was transferred into a pre-weighed beaker (M_i). The beaker with extracted fat was placed in a fume hood to evaporate the solvent on a steam bath until no odor of the solvent is detectable. Then the beaker with content was dried in an oven for 30 minutes at 100°C. Finally, the beaker with its contents was removed, cooled in a desiccator and weighed.

Data Collected

Seed yield, seed quality traits of groundnut genotypes and fungus occurrence(incidence) to the interaction of phosphorus and foliar zinc fertilizer were taken on a single plant basis. Rainfall data (mm) also record in the experimentation period at the site.

Crop Profitability

Simple partial budget analysis was employ for economic analysis of soil and foliar fertilizer application on groundnut. Which is cost of inputs, including seeds, fertilizers, labor and price of groundnut for revenue was assess. Value -Cost Ratio (VCR) was used to determine the ratio between the value of the additional crop yield and the cost of inputs as described by Bhatti (2006).

Data Analysis

Analysis of variance was performing using GenStat 14th Edition statistical package. When the interactions and main effects showed, significant difference was subject to Duncan's multiple range tests for mean separation at 5% level of significance.

RESULTS AND DISCUSSION

Properties of the Experimental Soil

Pre-planting soil analysis was performed in the laboratory of Tigray Agricultural Research Institute (TARI), Mekele soil laboratory for the major soil physical and chemical properties for the top soil (0-30 cm) indicated in (Table 3.1). Conferring to the laboratory analysis, the soil texture of the experimental area was loamy sand. Therefore, the soil texture of the study place is appropriate for groundnut production as the crop is grown mostly on light-textured soils ranging from coarse and fine sands to sandy clay loams (Onwueme and Sinha, 1991). As it can evidence from the result (Table 3.2) the experimental site is with total nitrogen content of 0.07%, 7.72 ppm available P and 0.09% organic matter, which was very low to support the growth of plants according to Sahlemedhin (2001).

Moreover, the pH value of the experimental soil was 7.25, indicated that the experimental soils are almost neutral within the ideal pH range value for groundnut production According Nkot *et al*. (2011) stated reduced groundnut nodulation and fixation of nitrogen in acid soils pH of 3.6 -6.9. The Electrical conductivity of the soil was measured as 0.045 ms/cm, which was also very low that indicates the experimental field was free of salt (Sahlemedhin, 2001). Soils having CEC of >40, 25-40, 15-25, 5-15, <5 cmol (+)/kg were categorized as very high, high, medium, low and very low respectively(Landon, 1991).Therefore, CEC of the experimental soil lies in a very low range, which means the soil has low capacity to hold and exchange cations.

Results from the soil analysis in the study area found potassium 238kg/ha, which was rated optimum for well growth of the crop (Landon, 1991).The micronutrients level of available Zinc (Zn) in the experimental site was found 5.52 ppm, which is Very low to groundnut production..

Table 3. 1: Some Physical characteristics of the soil at the experimental site

Properties	Values	Remark*
Soil texture		Loamy sand
Sand (%)	88	
Clay (%)	4	
Silt (%)	8	

* According to London (1991)

Table 3. 2: Some chemical characteristics of the soil at the experimental site

Properties	Values	Remark*
pH (by 1:2.5 soil water ratio)	7.25	Almost neutral
Total nitrogen (%)	0.07	Very low
Organic carbon (%)	0.09	Very low
Available phosphorus (ppm)	7.72	Very low
Available K_2O (kg/ha)	238	Optimum
Available Zn (ppm)	5.52	Very low
Cation exchange capacity (cmol(+)/kg/ha)	2.7	Very low
Electrical conductivity(ms/cm)	0.045	Very low

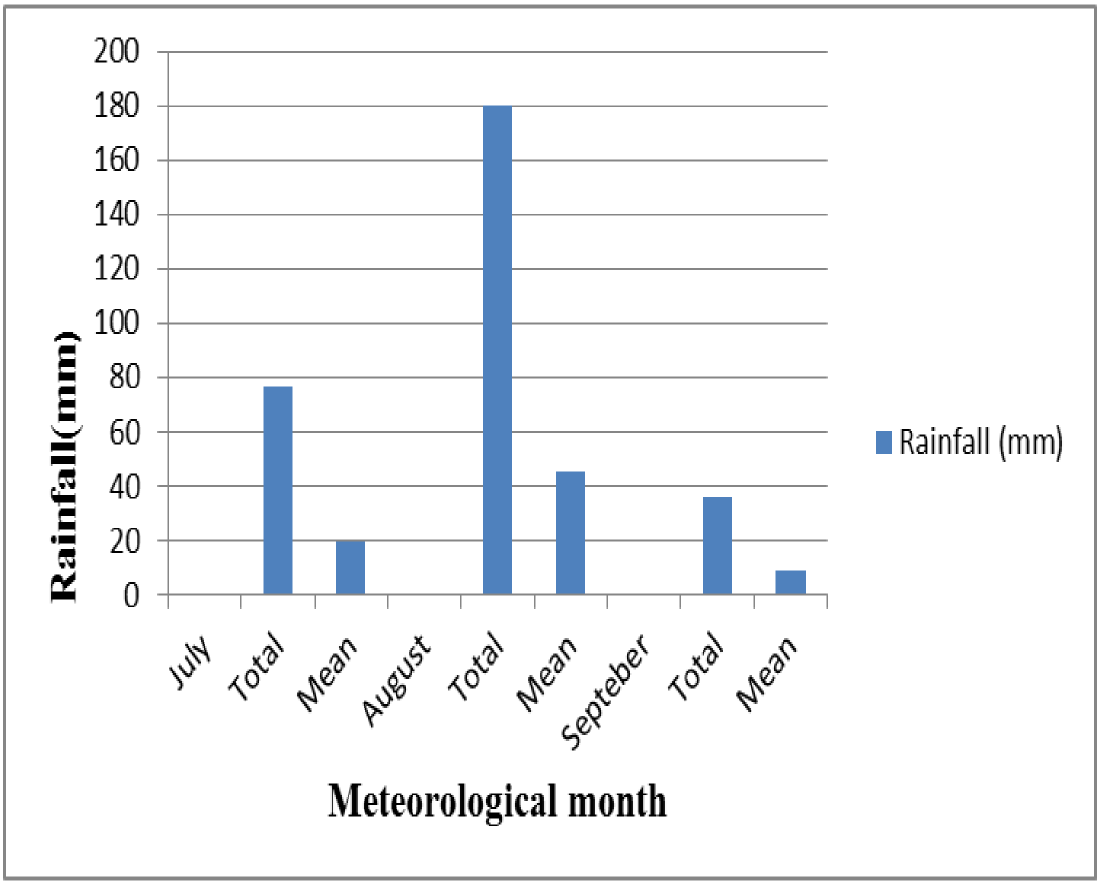

Figure 3. 1: The amount of rainfall of the study area during the experimentation period

Table 3. 3: The interaction effect of genotypes and interaction of PZn on seed yield kg/ha

Genotypes	Combined fertilizers				
	P_0Zn_0	$P_{10}Zn_{0.5}$	$P_{20}Zn_1$	$P_{30}Zn_{1.5}$	**Mean**
ICGV00308	1908^c	2205^b	2326^b	2378^{ab}	**2204^b**
ICGV91114	2204^b	2201^b	2221^b	2296^b	**2230^b**
Standard check(sedi)	2351^{ab}	2384^{ab}	2516^a	2529^a	**2445^a**
Mean	**2154^b**	**2263^{ab}**	**2354^a**	**2401^a**	
LSD(0.05)	170.8				
CV (%)	4.4				

Where P=kg/ha Zn=g/L, LSD (0.05) =Least Significant Difference at 5% level; CV= Coefficient of variation. The same letters in the table are indicating not significantly different at 5% level of significance.

Rainfall

The Rainfall pattern interval during the implementation period of the experiment is displayed in (Figure 3.1) total monthly rainfall reached from 36 mm to 180mm with highest total monthly recorded in August (180mm) while the lowest was recorded in July (36 mm).

Seed Yield kg/ha

Seed yield is the most economically important component of groundnut and directly affect by nutrients application rate and genetic character of a varieties. Concerning this result main effect of genotypes and joint fertilizers as well as the interaction effect were significant on seed yield of groundnut. As the analysis of variance indicated that the interaction effect of, interaction fertilizer and genotypes showed highly significance difference between the treatments ($p<0.01$) in which the highest seed yield (2529kg/ha) and (2516 kg/ha) was obtained from variety sedi with combine of 30kgP/ha+1.5gZn/L and 20kgP/ha+1gZn/L fertilizer respectively (Table 3.3).

While, the Low seed yield was recorded from the ICGV00308 genotype (1908 kg/ha) without application of fertilizer.As the above (Table 3.3) showed that, when the fertilizer level is increase, the trend displays no turning point to the maximum level of combined fertilizer on seed yield.

The greater interaction of phosphorus with foliar zinc application increase on number and weight of nodules and nitrogen activity which in turn positive contribution on groundnut yield traits and improve the plant performance is the possible reasons to high seed yields. Further, phosphorus fertilizer attributed to the activation of metabolic process as role of building phospholipids and nucleic acid stated by (Marschner 1986) and/or due to foliar spraying with zinc might be increase number of pods and seeds/plant, weight of pods and seeds/plant. Since zinc fertilizer could be attributes to vital roles to activate enzymes for biological process, which helps to increase yield characters. And agree with the work of Amanullah *et al*. (2016) reported that interaction of phosphorus with zinc indicated that the grain yield in maize improved meaningfully with the increase in both foliar Phosphorus and zinc levels and vice versa.

In addition to that, this treatment significant increase in seed yield may due to associated improvement in leaf length as foliar zinc increase enzymatic activation in leaf similar result to (Jeetarwal, 2013) finding.

Crude Protein (%)

The results presented in the (Table 3.3) shown that the main effect of combined fertilizer level and interaction effect of groundnut genotypes and the combined fertilizer of phosphorus with foliar application of zinc had highly significant ($P<0.01$) the effect on crude protein content. The standard check variety (sedi) with the combined application of 30kgP/ha+1.5gZn/L was extracted highest crude protein content (37.79%). Although the lowest protein content was also revealed in the same variety sedi with combined application of 10kgP/ha+0.5gZn/L (35.90%) which is significantly different (Table 3.3). This treatment increased 5.27% over the lowest crude protein was recorded.

Table 3.3: The interaction effect of genotypes and combination of PZn fertilizers on protein content (%) of groundnut

Genotypes	Combined fertilizers				
	P_0Zn_0	$P_{10}Zn_{0.5}$	$P_{20}Zn_1$	$P_{30}Zn_{1.5}$	Mean
ICGV00308	36.78^{bc}	37.25^{abc}	37.46^{ab}	37.46^{ab}	37.24^{a}
ICGV91114	37.13^{abc}	37.10^{abc}	36.65^{c}	37.03^{bc}	36.98^{a}
Standard check(sedi)	36.69^{bc}	35.90^{d}	37.36^{abc}	37.79^{a}	36.94^{a}
Mean	36.87^{a}	36.75^{a}	37.16^{a}	37.43^{a}	
LSD(0.05)	0.6938				
CV (%)	1.0				

Where P=kg/ha Zn=g/L

Table 3.4: The interaction result of genotypes and combination of PZn on fat (%) of groundnut

Genotypes	Combined fertilizers				
	P_0Zn_0	$P_{10}Zn_{0.5}$	$P_{20}Zn_1$	$P_{30}Zn_{1.5}$	**Mean**
ICGV00308	43.67[abc]	43.76[ab]	43.91[a]	43.95[a]	43.81[a]
ICGV91114	42.03[d]	41.45[d]	41.71[d]	43[bc]	42.04[b]
Standard check(sedi)	41.78[d]	41.93[d]	43.63[abc]	42.9[c]	42.56[b]
Mean	42.49[b]	41.71[c]	43.08[ab]	43.28[a]	
LSD(0.05)	0.7122				
CV (%)	1.1				

Where P=kg/ha Zn=g/L, LSD (0.05) =Least Significant Difference at 5% level; CV= Coefficient of variation.

The present study showed that application of combined fertilizer had an interaction effect with the genotypes. This finding in crude protein (%) of the genotype provided 36.69-37.79 agreement with the result of Okello *et al*. (2010) indicated that groundnut kernel gives 20-50% protein content. This result implies that nutritional content of the variety is under standard as the result obtained in the investigation is found in the range of the internationally range of groundnut protein content.

This result is may be due to the contribution of the genotype difference and/or interaction application of phosphorus with foliar zinc. Hence, the phosphorus fertilizer might have enhanced the nutritional situation in rhizosphere and plant system leading to improve uptake and translocation of nutrients specially NP and Zn which promote to higher content of nutrients. Since protein is essentially the manifestation of nitrogen in the seeds. As a result, enhancing the nitrogen content may increase protein content. Investigation of Jeetarwal (2013) confirm the result and similar result to Majumdar *et al*. (2001) application of phosphorus up to 70kgP2O5/ha increasing protein content of the crop and Gobarah *et al*. (2006) also reported that P application significantly increased protein contents (25.82%) on groundnut over control. Implication of this result phosphorus application is very important element to enhance nutritional content of groundnut crop.

Furthermore, in fact foliar spraying with zinc had significant effect in protein content and NPK concentration. This result also might be due to the increasing foliar zinc by means of helps protein synthesis and it increase cause of energy as that zinc increases source of energy for biochemical response to synthesis protein contents.

Fat (%)

The analysis of the result indicated that the main effect genotype and combined fertilizer level and interaction effect of fertilizer level with genotypes was highly significant difference ($p<0.01$). As the (Table 3.4) below showed that the highest percentage of fat (43.95%) were extracted from the ICGV00308 genotype with the highest level of combine fertilizer (30kgP/ha+1.5gZn/L) followed by ICGV00308 genotype with (20kgP/ha+1gZn/L) combine fertilizer application. While the lowest percentage of fat was recorded from the treatment, which is control and low fertilizer levels.

The same letters in the table are indicating not significantly different at 5% level of significance.

The current investigation revealed that application of combine of PZn fertilizer had an interaction effect with the genotypes. This finding in fat (%) of the genotype provided 41.44-43.95% respectively agreement with the result of Okello *et al*. (2010) indicated that groundnut kernel gives 40-50% fat contents.

Response of the fat content due to the interaction of genotypes and combined fertilizer level are revealing strong positive effect in the fat proportion of groundnut, which recorded highest percentage from the treatment, which had applied highest combined fertilizer levels. These results may be due the influence of combined fertilizer as foliar zinc application is directed by the availability of nutrients in the plant where nutrient absorption is restricted in the soil and/or genetic difference between the genotype since the main effect also show highly significance difference separately.

As the result displayed the highest fat percentage is extracted from the ICVG00308 genotype showed increasing trend from control to maximum level of combined fertilizer levels. These result obtained may be due to cooperative effect of phosphorus with zinc on metabolic process and growth which in turn reflected positively on chemical content of groundnut seed. Similar to the idea of Mirvat *et al*.(2006) reported that maximum oil content and fat in kernels of groundnut is may due to application of those fertilizer.

Effect of Genotypes and interaction of Fertilizers in Occurrence of Fungi (%) on Groundnut

As the (figure 3.4) indicated that, occurrence of fungi in the experiment due to the treatments are not affected through the combined application of phosphorus (TSP) and foliar zinc ($ZnSO4\ 7H_2o$). However, there is a different between the genotypes, which recorded highest percentage of fungus (35%) from the standard check (sedi) variety. Nevertheless, the lowest incidence of fungus was observed from the genotype ICGV00308 and ICGV91114 (9%) and (11%) respectively. This indicated that the fungus occurred in the genotypes are coming from the seed since the material taking from the area which is shown highly incidence of fungi (Gebreselassie *et al*., 2014) which is the standard check sedi variety commonly cultivated in the district Hadnet, Abergelle. However, the other genotype are not cultivated before in the area is low incidence, so this might be the area is not infected by the fungus.

Therefore, as the result detected that the occurrence of the fungus in the experimental area sheka tekli, Abergele is low. Implication of this result sowed that the aspergillus fungi is soli and seed born disease. Besides, according the result the fungus is most probable seed born because of the seed coming from the infected area showed higher infestation than the other new genotypes not cultivated before in the area. So, even some percentage of fungi occurred in the standard check might be from the seed so no need further going to do aflatoxin analysis.

Table A3.5: Analysis variance for seed yield kg/ha, crude protein and fat content (%)

Source of variation	Mean squares			
	D.f	Seed yield kg/ha	Crude protein (%)	Fat (%)
Replication	2	2.1	0.0158	0.0212
Genotypes(MP)	2	209296*	0.3162Ns	9.9869**
Error	4	19922	0.2538	0.0026
Combined fertilizer(SP)	3	106818**	0.8216**	1.7652**
G*F	6	28411**	0.8416**	0.9743**
Error	18	8007	0.1316	0.2292

Where: MP=Main plot, SP=Sub plot, ** highly significant at $p<0.01$, * Significant different at $p<0.05$, NS = Non significant difference

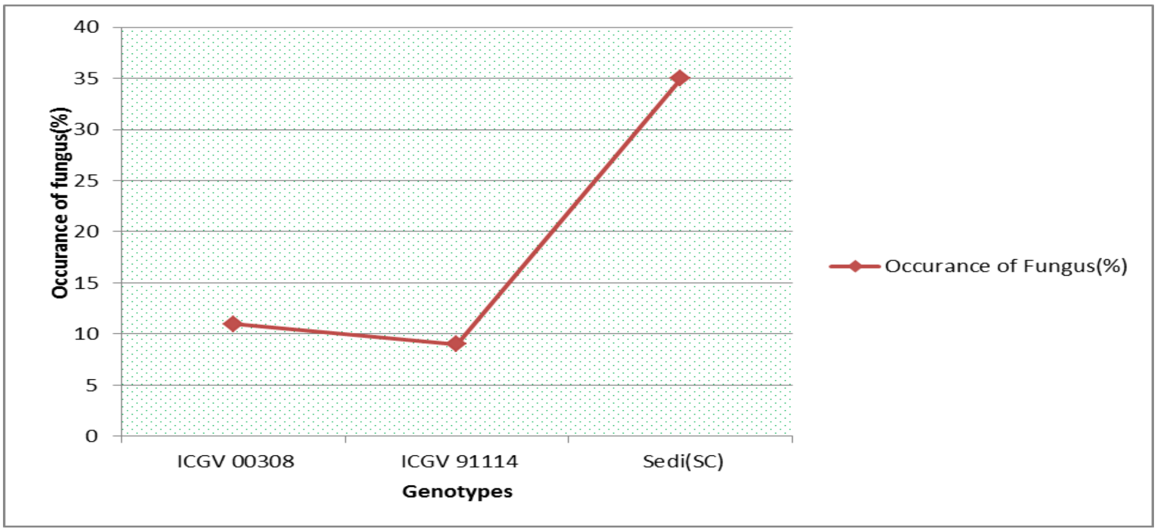

Figure 3. 2: Main effect of genotypes in occurrence of fungus (%) on groundnut

Table 3.6: Comparative partial budget analysis of different treatment combinations

S.n	Treatment combination(P kg/ha+Zn g/l)	Total treatment cost (birr/ha)	Seed yield (kg/ha)	Haulm yield kg/ha	Returns seed yield (birr/ha)	Returns haulm yield (birr/ha)	Total returns birr/ha	Net returns(birr/ha	B:c ratio
1	P_0Zn_0+G1	37901.2	1908	4950.5	47700	14851.35	62551.35	24650.15	0.65
2	$P_{10}Zn_{0.5}$+G1	38828.7	2205	5721	55125	17163.09	72288.09	33459.39	0.86
3	$P_{20}Zn_1$+G1	39756.2	2326	6035	58150	18104.94	76254.94	36498.74	0.92
4	$P_{30}Zn_{1.5}$+G1	40683.7	2378	6169.9	59450	18509.7	77959.7	37276	0.92
5	P_0Zn_0+G_2	37901.2	2204	5718.4	55100	17155.32	72255.32	34354.12	0.91
6	$P_{10}Zn_{0.5}$+ G_2	38828.7	2201	5710.7	55025	17131.98	72156.98	33328.28	0.86
7	$P_{20}Zn_1$+ G_2	39756.2	2221	5762.6	55525	17287.65	72812.65	33056.45	0.83
8	$P_{30}Zn_{1.5}$+ G_2	40683.7	2296	5957.1	57400	17871.42	75271.42	34587.72	0.85
9	P_0Zn_0+ G_3	37901.2	2351	6099.8	58775	18299.52	77074.52	39173.32	1.03
10	$P_{10}Zn_{0.5}$+ G_3	38828.7	2384	6185.5	59600	18556.38	78156.38	39327.68	1.01
11	$P_{20}Zn_1$+ G_3	39756.2	2516	6428	62900	19283.9	82183.9	42427.65	1.07
12	$P_{30}Zn_{1.5}$+ G_3	40683.7	2529	6992.7	63225	20978	84203	43519.34	1.07

Price of ZnSO4 =853birr/500 gram, TSP (Triple super phosphate) =1855birr/Qt , Sale price of groundnut seed =25birr/kg, Sale price of groundnut haulm 3birr/kg, B:C ratio=Benefit cost ratio and Mrr= Marginal rate of return

Partial Budget Analysis

Details of cost of cultivation for the groundnut genotypes were operated beside on the prevailing market rates of inputs, labor and produce throughout the crop growing period. In order to assess the economic feasibility of different treatments in terms of net returns ETB/ha the production increased of the crop due to the application of inputs might or might not be beneficiary to farmers. Therefore, partial budget analysis (CIMMYT, 1988) was employed to estimate the net benefit and marginal rate of return that could be obtained from various alternative treatments. The net benefit estimate for 12 treatments is presented in (Table 3.6) Combined application of 30 kg p/ha with 1.5g/L ZnSO4 to the standard check of sedi variety gives a net Returns (43519.34 ETB) followed by 20 kg P/ha with 1g/L ZnSO4 to the standard check of sedi, which had given 42,427.65ETB net returns. The lowest net benefit was obtained from production of groundnut without fertilizer application on ICGV00308 genotype followed by the treatments obtained from ICGV00308+10 kg P /ha +0.50 g ZnSO4 $7H_2o$ with net returns of 24,650.15 ETB and (33459.39 ETB) respectively. The low net returns obtained might be due to low yields gained from the treatment combinations.

This indicated that as the total costs that very increased until to this level the net returns also increased due to high yields. However, as the fertilizer level are lesser the net returns obtained reduced as the result of lower yields gained from the genotype without application of fertilizer showed in the table below.

Due to combined application of phosphorus with foliar zinc (30kgP/ha+1.5gZn/L) on the groundnut variety (sedi) proved more encouraging and raised significant higher net returns (43,519.34ETB/ha) and benefit cost ratio (B:C) (1.07) over the control(39,173.32ETB) and (1.03) respectively within the variety and it is economically feasible as compared to the other treatments (Table 3.6). Similar to Badza (2014) reports achievement of the best net returns of groundnut is from the application of fertilizer. This increment is due to increasing of seed yields as enhanced by the combined fertilizer may be due to phosphorus as promoting high nodulation, and foliar zinc as encouraged the vegetative growth, enlarged the plant capacity for building metabolites and play an activator of several enzymes in the plant.

CONCLUSION AND RECOMMENDATIONS

The result of field experiment executed in Aberegele district revealed encouraging response of the crop to genotypes and interaction P&Zn application, which implied that those factors was the most limiting features for production of groundnut in the loamy sand soil of dryland area. A significant effect on seed yield and seed quality traits of the crop showed an interaction effects. The interaction effect of combined PZn fertilizer and genotypes are positive significant influence on seed yield/ha, crude protein and fat (%)

of the crop. The main effect of genotypes is shows significant difference on the fungus occurrence.

The highest seed yield (2529kg/ha) was obtained from the interaction effect of (30kgP/ha+1.5gZn/L) optimum dose with sedi variety is, may be due to the contribution of fertilizer to yield and genetic character of the variety under existing soil and climatic conditions. This is useful investment for smallholder farmers as contributed to enhance seed yield, protein and fat (%) contents and net returns of groundnut. Therefore, the mentioned rate of P and foliar Zn application for this soil to encounter the antagonistic effect of vise verse.

Generally, with the advantage yield the extra net returns raised (11.1%) over the variety without fertilized. So, from this report conclude that, combined application of P with foliar Zn is very important to the smallholder farming system and other stakeholders, as it increase seed yield, protein and fat content and net returns of groundnut on loamy sand soils of dryland area.

Recommendations

This finding was shows highly significant difference at all the parameters so, it may be conclude that, as the result combined application of (30kgP/ha+1.5gZn/L) with sedi variety had a significant effect on seed yield, protein and fat content, fungus occurrence and net returns of groundnut.

Therefore, it may use as a tool to further research. However, as the study executed in one season and single location, it has to be repeated for further confirmation in multi locations and seasons consider the aspects, such as nutrient use efficiencies and nutrient uptake rate need to be explore to know how much nutritional quality will be added due to the application of those fertilizers.

Furthermore, increasing the number of genotypes and experimented in the aspergilli's fungi infected area to be determine the response of genotypes and integrated application of PZn fertilizer to the fungi and its consequences aflatoxin level to more reliable recommendation in the groundnut producing areas.

Acknowledgement

The authors highly thankful to Tigray Agricultural Research Institute (TARI) and NORHED-Sweet Potato Project Mekele University for financial support, which permitted to undertake this research. They also gratefully acknowledge to Ethiopian Public Health Institute (EPHI) for analysis seed quality content on time and grateful to technicians of Mekelle soil laboratories and ezana analatical laboratory for generous cooperation during analysis of the soil. Lastly, authors are grateful to plant pathology laboratory of Mekelle University for their support to fungus infection analysis on groundnut seed.

Conflict of Interest

The author declares that there is no conflict of interest.

REFERENCES

Adinya IB, Enun EE and Ijoma JU (2010) Exploring profitability potentials in groundnut production through agroforestry practices: A case study in Nigeria. Journal of Animal and Plant Sciences 20(2): 123 – 131.

Amanullah Saleem A, Iqbal A, Fahad S (2016) Foliar Phosphorus and Zinc Application Improve Growth and Productivity of Maize (Zea mays L.) Under Moisture Stress conditions in Semi-Arid Climates. *J Microb Biochem Technol* 8: 433-439. doi: 10.4172/1948-5948.100032

Bhatti AU (2006) Statistical Procedures for Analysis of Agriculture Research Experiments. Department of Soil and Environmental Sciences, University Peshawar, Pakistan. 115pp.

Central Statistics of Agency (CSA) of Ethiopia. 2013. Agricultural Sample Survey Report

CIMMYT economics program (1988) From agronomic data to farmer recommendations: An economics training manual,(No 27): CIMMYT.

CSA (Central Statistics Agency) (2014) Report on Area and Production of Major Crops (Private Peasant Holdings, Meher Season): Agricultural Sample Survey. Central Statistics Agency, Addis Ababa, Ethiopia

Dereje Assefa, Muez Teare and Helge Skinnes (2012) Natural occurrence of toxigenic fungi species and aflatoxinin freshly harvested groundnut kernels in Tigray, northern Ethiopia. *Journal of the Drylands* 5 (1): 377-384.

Gebreselassie R, Dereje A and Solomon H (2014) On Farm Pre Harvest, Agronomic Management Practices of Aspergillus Infection on Groundnut in Abergelle, Tigray. *J Plant Pathol. Microb*. 5(2): 1-6

Gezahagn K (2013) Economics of Groundnut Production in East Hararghe Zone of Oromia Regional State, Ethiopia.*Sci.,Technol.Arts Res*. J.2(2): 135-139

Gobarah Mirvat E, Mohamed Magda H and Tawfik MM (2006) Effect of phosphorus fertilizer and foliar spraying with zinc on growth, yield and quality of groundnut under reclaimed sandy soils. *Journal of Applied Science Research*, 2(8): 491-496.

Jeetarwal RL (2013) Response of groundnut [Arachis hypogaea L.)..unpublished M.S.c thesis Swami Keshwanand Rajasthan Agricultural

Landon JR (1991) Booker tropical soil manual. a hand book for soil survey and agricultural land evaluation in the tropics and sub tropics. *Longman publishers*, New York. 474pp.

Majumdar B,Venkatesh MS, Lal B, Kailash Kumar and Singh CS (2001) Effect of phosphorus and zinc nutrition on groundnut in an acid hapludalf of Meghalaya. Annals of Agricultural Research, 22(3): 354-359.

Marschner H (1986) Mineral Nutrition of Higher Plants. Inst. of Plant Nutrition, Univ. of Hoheheim, F.R.G. *Academic. Prss, Harcout, Brace. Jovanvich Publisher*. London.

Mirvat EG, Mohamed MH, Tawfik MM (2006)Effect of phosphorus fertilizer and foliar spraying with zinc on growth, yield and quality of groundnut under reclaimed sandy soils. *Journal of Applied Science Research*, 2(8): 491-496.

Nkot L, Nwaga D, Ngakou A, Fankem H and Etoa F (2011) Variation in nodulation and growth of groundnut (Arachis hypogaea L.) on oxisols from land use systems of the humid forest zone in southern Cameroon. *African Journal of Biotechnology* 10(20): 3996 – 4004.

Okello DK, Biruma M and Deom CM (2010) Overview of groundnuts research in Uganda: Past, present and future. *African Journal of Biotechnology* 9(39): 6448 – 6459.

Onwueme IC and Sinha TD (1991) Field crop production in Tropical Africa, Principles and practice, CTA (Technical center for agriculture and rural cooperation) The Netherlands Optimizing use of integrated soil fertility management options for profitable groundnut production in Uganda. Agriculture and Soil Sciences 1(5): 61 – 69.

Sahlemedhin Sertsu (2001) Analytical Data Evaluation and Interpretation. National Soil Research Center. Ethiopian Agricultural Research Organization (EARO), Addis Ababa, Ethiopia. 10p.

Taru VB, Kyagya IZ and Mshelia SI (2010) Profitability of groundnut production In Michika Local Government Area of Adamawa State, Nigeria. *Journal of gricultural Science* 1(1): 25 – 29.