Evaluation of Harvesting Time on Seed Quality of Groundnut (*ArachisHypogaea*L.) in Assosa District, Western Ethiopia

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Abstract

Groundnut is an important food and cash crop in the BenishangulGumuz region of Ethiopia. However, inappropriate harvesting times constrain the seed quality of the crop. Therefore, field and laboratory experiments were conducted to evaluate the effect of harvesting time on seed quality of two groundnut varieties (Manipintar and Bulki). Analysis of field experiment data revealed that variety and harvesting time interacted to significantly ($P < 0.05$) influence all parameters studied except seed physical purity, moisture content, and vigor index. Both varieties had significantly higher seed quality parameters when harvested at their respective expected physiological maturity. At 14 days before expected physiological maturity, both varieties produced the lowest quality seeds. Generally, physical purity and seed moisture contents at all stages of harvesting except 21 days after the expected time of maturity as well as standard germination of both varieties harvested at or immediately before and after the expected times of maturity met the minimum national groundnut seed quality standard of Ethiopia. Seed health analysis revealed that eight fungal genera and two bacteria species were detected on seed samples harvested at different times. Manipintar was infected significantly higher than Bulki at all harvesting times except at the expected time of physiological maturity.

Key words: *Groundnut, Harvesting time,Seed quality,Seed Healthy, physiological maturity*.

I. INTRODUCTION

Groundnut is one of the three economically most important oilseed crops including noug (*Guizot abyssinica.L*) and sesame (*Sesamumindicum*) in Ethiopia [8]. It is important as food, cash crop and improving the soil nitrogen status in the semi-arid areas of Ethiopia [2]. In Assosa district, some smallholder farmers procure seeds of improved groundnut varieties from Assosa Agricultural Research Centre. However, most smallholder farmers use farm-saved recycled seed in one year or the other. Farmers often harvest before the plant reaches sufficient physiological maturity owing to the fact that the crop fetches higher prices in the local market at the early production time than at peak production time and aimed at pre-empting attack of wild animals on their crops in the field. Delayed harvesting of groundnut is a routine practice in the region also because both smallholders, as well as large-scale farmers, face a shortage of labor during peak harvesting times [18]. The delayed harvesting is one of the major causes for the occurrence of post-harvest aflatoxin on groundnut. Furthermore, farmers have low awareness and knowledge on aflatoxin contamination of groundnut. Ref [11] revealed that lack of visual indication on the seed was the major factor for farmers' unawareness on aflatoxin contamination of groundnut seeds. The seed that has been saved from early and delayed harvests is sown. Seeds used for planting that way could cause poor crop stands in the field. In addition, when farmers do replacement sowing to substitute those un-germinated seeds a week or so after the original sowing, the crop often reaches harvestable growth stage at different times causing patchy fields in terms of physiological maturity. Thus, there will be a propensity to harvest the crop at different times. Harvesting the crop at different maturity times severely affects the quality of seed that will be saved and used in the next season for planting. This research was, therefore, carried out with the objective of determining the influence of harvesting time on seed quality of groundnut.

II. MATERIALS AND METHODS

The treatments of the field experiment consisted of two groundnut varieties (Manipintar, Bulki) and six harvesting times [(i) fourteen days before expected harvest maturity (14-DBEM), (ii) seven days before expected harvest maturity (7-DBEM), (iii) at expected harvest maturity (EM), (iv) seven days after expected harvest maturity (7-DAEM), (v) fourteen days after expected harvest maturity (14-DAEM), and (vi) twenty-one days after expected harvest maturity (21-DAEM)]. The experiment was laid out as a randomized complete block design in a factorial arrangement and replicated three times. Plots were 2.70 m by 3 m. Treatments were assigned to each plot randomly. The seeds were sown at the spacing of 40 cm between rows and 10 cm between plants. The spacing between plots and blocks was 0.5 m and 1m respectively. Only plants in the five middle rows were manually harvested, and the pods were detached from the mother plant and dried under shade for two

weeks until the moisture content reached between 5 and 8% for estimation of seed quality at the specified stage of growth. Based on the results of the adaptation trials conducted at the Assosa Agricultural Research Centres the expected time of physiological maturity of Bulki&Manipintar variety was taken as 157 & 163 days after sowing consecutively[4].

A. Field and Laboratory Data Collection

Samples of harvested seed were estimated for Seed quality parameters including physical quality (purity analysis), seed moisture content analysis, physiological quality (standard germination test, seedling shoot and root length, seedling dry weight, vigor index-I and vigor index-II, speed of germination test and field emergence index and seed health test at Holetta Agricultural Research Centre. All tests were performed according to procedures described by [10].

B. Data Analysis

All data were subjected to analysis of variance (ANOVA) using the Generalized Linear Model (GLM) method of SAS [17]. Differences between treatment means were separated using the Least Significant Difference (LSD) test at 5% level of significance.

III. RESULTS AND DISCUSSION

The sample of harvested seed from different treatments combination were evaluated for seed quality and discussed as follows:

A. Moisture content during harvesting

Harvesting time had significantly influenced seed moisture content. However, variety, as well as the interaction effect of variety and harvesting time, did not. Harvesting the crop 14-DBEM resulted in the highest (43.10%) seed moisture content whereas harvesting 21-DAEM resulted in the lowest (26.59%) seed moisture content (Table I). This result of the study is in accordance with that of [15] who reported that moisture content of pod when harvesting was done 10 days earlier than the expected time of harvesting by farmers was about 39-52% higher compared to the moisture content of pods harvested 10 days later than the expected harvest time by farmers. This might be attributed to the phenomenon that, at too early harvesting, the seed might still be at milk stage of seed filling, with high moisture contents

TABLE IThe main effect of variety and harvesting time on moisture content at harvest and number of percentage of pure seeds

Treatment	Parameters	
Variety	**Moisture Content at Harvest**	**Pure Seed**
Bulki (B)	35.33a	99.46a
Manipintar (M)	35.74a	99.27a
LSD (0.05)	ns	ns
Harvesting Time		
14-DBEM	43.10a	98.77b
7-DBEM	39.01b	98.87b
EM	35.88b	99.78a
7-DAEM	37.47b	99.69a
14-DAEM	31.18c	99.54a
21-DAEM	26.59d	99.53a
LSD (0.05)	3.27	0.51
CV (%)	7.68	0.43

Means followed by the same letter within a column are not significantly different at 5% level of significance. lsd = least significant difference; cv = coefficient of variation; d= days; b= before; e= expected; m= maturity; a= after.

Seeds from delayed harvesting also may have a relatively higher moisture content, which provides ample opportunities for pathogens and other rot organisms to proliferate. This result is in agreement with that of [6] who emphasized that too early harvested seeds will shrink when drying, which lowers the oil content and quality of the seed. Also delayed harvesting results in poor quality seeds due to mold development and subsequent, aflatoxin contamination of the seeds or pods

B. Analytical Purity

Percentage of pure seeds was significantly ($P < 0.01$) influenced by harvesting time. However, variety, and interaction of harvesting time and variety did not interact to influence. (Table I). The lowest seed purity percentages were recorded when the crop was harvested 14 and seven-DBEM. However, harvesting the crop at the EM as well as at the later stages of maturity resulted in superior percentages of pure seed, all of which were in statistical parity.

C. Moisture content during seed quality test

The main, as well as the interaction effects of variety and harvesting time highly significantly ($P \leq 0.01$), affected the moisture content of the seed.

All groundnut harvested at different harvesting times were dried under shade for 14 days. The results revealed that the highest mean value of MC (8.06%) was observed when Manipintar was harvested at 14-DAEM and the lowest (3.70%) was recorded when Bulki was harvested at 14-DBEM. The moisture contents of groundnut harvested at EM were significantly reduced compared to the moisture contents of groundnut harvested after the expected physiological maturity (Table II). This might be due

to low dry matter accumulation of seeds at early harvesting times. Under the weather condition of the study area, the moisture content of groundnut can be reduced to safe moisture level if dried under shade up to 14 days. Ref [15] stated that the mean pod moisture content at the time of harvest when done 10 days earlier than the normal harvest time was very high (39–52%). However, the mean seed moisture content, after either 1 or 3 months storage, was reduced dramatically to below 9%.

D. Standard germination

The analysis of variance showed that the main as well as the interaction effects of variety and harvesting time significantly ($P < 0.05$) affected standard germination.

The highest mean value (98.61%) of germination was observed for Bulki harvested at the EM as well as for Manipintar (97.57%) harvested at the corresponding time of its maturity. The lowest (63.74%) mean value was recorded in response to harvesting Manipintar 14-DBEM (Table II). The reduced standard germination percentage in response to early harvesting might be due to the fact that seeds in early harvested pods may not have accumulated sufficient amounts of biochemicals promoting germination. On the other hand, the reduced germination in response to late harvesting might be attributed to the loss of viability seeds due to physical factors such as harvest damage by humans as well as due to attacks by pests and infections by pathogens.

TABLE II . The interaction effect of harvesting time and variety on inert matter, moisture content and standard germination in Assosa during the main cropping season of 2011

Variety	Treatments	Parameters		
	Harvesting Time	Inert Matter	Moisture Content	Standard Germination
Bulki (B)	14-DBEM	1.13b	3.70k	71.06g
	7-DBEM	0.916c	4.20j	83.56def
	EM	0.13f	5.72f	98.61a
	7-DAEM	0.256ef	6.31d	91.86b
	14-DAEM	0.506d	4.65h	85.25cde
	21-DAEM	0.476d	6.55c	80.63f
Manipintar (M)	14-DBEM	1.50a	5.36g	63.74h
	7-DBEM	1.34a	5.70f	87.76c
	EM	0.31def	5.93e	97.57a
	7-DAEM	0.366de	4.55i	85.79cd
	14-DAEM	0.406de	8.06a	83.78def
	HT-21-DAEM	0.456d	7.90c	81.84f
LSD (0.05)		0.19	0.08	3.62
CV (%)		17.685	0.83	2.55

Means followed by the same letter within a column are not significantly different at 5% level of significance. LSD = Least significant difference; CV = Coefficient of variation; D= Days; B=Before; E= Expected; M= Maturity; A= After.

This result is in line with that of [7] who reported that pods harvested early 85 days after emergence had only immature non-germinal seeds with higher moisture contents. However, for those harvested at 105 days after emergence or after, the percentage of mature seeds increased steadily, seed moisture content declined rapidly, and seed germination percentage increased significantly, indicating that harvesting should be done between 110 and 120 days after emergence to obtain high-quality seeds. Standard germination for all seeds harvested at different harvesting times showed germination percentage amounting to 85% which was above the required minimum seeds certification standard. However, harvesting varieties 14-DBEM and 21-DAEM, as well as harvesting Bulki seven-DBEM and Manipintar 14-DAEM, resulted in seed germination percentages that were below the minimum standard (Table II).

E. Number of normal seedlings

The analysis of variance showed that except variety main effect of harvesting time as well as its interaction with varieties highly significantly ($P \leq 0.01$) affected the number of normal seedlings. Generally, the number of normal seedlings decreased in response to both early and late harvesting for both varieties and increased in response to harvesting at and near the expected time of maturity. The highest number of normal seedlings was recorded for seeds of both varieties that were harvested at the EM. This was closely followed by seeds of Manipintar

harvested seven-DBEM as well as seeds of Bulki harvested seven-DAEM time. The lowest number of normal seedlings was recorded for seeds of Bulki in response to harvesting the crop 14-DBEM, closely followed by seeds of Manipintar harvested at the corresponding stage of maturity (Table III). Thus, the number of normal seedlings recorded for seeds of Manipintar harvested at the EM exceeded the number of normal seedlings obtained from seeds of the same variety harvested 14 DBEM by about 53%. Similarly, the number of normal seedlings recorded for seeds of Bulki harvested at the EM exceeded the number of normal seedlings obtained from seeds of the same variety harvested 14-DBEM by about 29% (Table III)..

F. Number of abnormal seedlings

The number of abnormal seedlings differed highly significantly ($P < 0.01$) in response to harvesting times. Treatment combination of harvesting times with varieties interacted to influence significantly the number of normal seedlings.

The number of abnormal seedlings generally increased with too early as well as too late harvesting. This might be due to under-developed seeds at early harvest and deterioration of seeds by biotic and abiotic factors for seeds of delayed harvests. For a variety of Manipintar, the highest number of abnormal seedlings was recorded in response to harvesting 14-DBEM time as well as harvesting 21-DAEM. This was followed by the number of abnormal seedlings obtained in response to harvesting the crop 14-DAEM. Similarly, seeds of the Bulki harvested 14 and 21-DAEM produced the highest number of abnormal seedlings. This was closely followed by seeds of the same variety harvested 14-DBEM as well as seeds harvested 14-DAEM and seven-DAEM time. The lowest number of abnormal seedlings was recorded for both varieties when harvesting was done at the expected maturity times (Table III). This might be due to well developments of seeds at expected maturity and harvested seeds at proper harvesting time. Ref [20] reported that seeds which contain sufficient stored foods have high ATP and activates normal plant growth than the abnormal one.

TABLE III Interaction effect of harvesting time and variety on the numbers of normal and abnormal seedlings and number of fresh ungerminated seeds of groundnut in Assosa during the main growing season of 2011

Variety	Treatments	Parameters		
	Harvesting Time	Number of Normal Seedlings	Abnormal Seedlings	Number of Fresh Ungerminated Seeds
Bulki (B)	14-DBEM	23.68f	2.43cd	5.16a
	7-DBEM	27.86cde	1.36ef	3.26b
	EM	32.87a	0.24g	0.12e
	7-DAEM	30.63b	2.13de	0.11e
	14-DAEM	28.42cd	3.45ab	0.81d
	21-DAEM	26.87e	3.44ab	0.57de
Manipintar (M)	14-DBEM	21.25g	3.76a	5.50a
	7-DBEM	29.26bc	1.20def	3.26b
	EM	32.52a	0.81fg	0.00e
	7-DAEM	28.60cd	2.74bcd	0.11e
	14-DAEM	27.94cde	3.20abc	0.32de
	21-DAEM	27.28de	2.61bcd	0.33de
LSD (0.05)		1.47	1.04	0.68
CV (%)		3.1	24.95	26.76

Means followed by the same letter within a column are not significantly different at 5% level of significance. LSD = Least significant difference; CV = Coefficient of variation; D= Days; B=Before; E= Expected; M= Maturity; A=After.

The superiority of seeds harvested at EM in a number of normal seedlings might be due to better development of kernels and nutrition. This might also be explained by the fact that seeds harvested earlier than the time of physiological maturity may have been underdeveloped and shrank with the result that a sizable number of them might not be able to grow to normal seedlings. This result is consistent with that of [7] who reported that seed germination percentage increased significantly in response to harvesting at maturity, indicating that harvesting should be done between 110 and 120 days after emergence to obtain high-quality seeds rather than early 85 and 105 days after emergence as observed for the experiment of these authors.

G. Number of fresh ungerminated seeds

The analysis of variance revealed that the main effect of variety, harvesting time and their interaction were significantly affected the number of

fresh ungerminated seeds. In this study for both varieties, the highest numbers of fresh ungerminated seeds were obtained in response to early harvesting compared to harvesting at the expected maturity time as well as harvesting at the later stages of growth (Table III). Thus, the highest number of ungerminated fresh seeds was recorded for both varieties when harvesting was done 14 and seven days earlier than the expected maturity. Thus, for both varieties, the lowest number of fresh ungerminated seeds was obtained when harvesting was done at the EM as well as at all subsequent later stages. This result agreed with [7] who reported that pods harvested at 85 days after emergence (early harvested) showed only immature non-germinable seeds with higher moisture content. Moreover, [21] reported that higher content of sugars in immature seed may make it prone to imbibitional injury, leading to poor germination.

TABLE IV . Effects of variety and harvesting time on number of dead seeds, average shoot and root length of groundnut in Assosa during the main growing season of 2011

Treatments	Parameters		
Variety	**Number of Dead Seeds**	**Average Shoot Length (cm)**	**Average Root Length (cm)**
Bulki (B)	1.10b	14.20a	14.53b
Manipintar (M)	1.80a	14.57a	16.48a
LSD (0.05)	0.32	Ns	0.99
Harvesting Times			
14-DBEM	2.45a	11.13e	12.86d
7-DBEM	0.97b	13.62c	14.90bc
EM	0.05c	19.07a	18.49a
7-DAEM	1.18b	16.35b	18.00a
14-DAEM	1.27b	13.61c	15.33b
21-DAEM	2.78a	12.54d	13.44cd
LSD (0.05)	0.55	1.02	1.72
CV (%)	31.97	5.96	9.33

Means followed by the same letter within a column are not significantly different at 5% level of significance. LSD = Least significant difference; CV = Coefficient of variation; D= Days; B=Before; E= Expected; M= Maturity; A= After.

H. Average shoot and root length

There were no significant differences between the two varieties in terms of average shoot length. However, the analysis of variance revealed that average shoot length significantly differed in response to harvesting time, and increased up to the expected time physiological maturity after which it declined drastically. The highest average shoot length (19.03 cm) was observed when harvesting was done at EM while the shortest length (12.54 cm) was recorded when harvesting was done 14 times.

Manipintar had about 13% significantly longer root than Bulki. The longest roots were recorded for groundnut plants harvested at the EM time as well as for plants harvested seven-DBEM time. Harvesting the crop at the EM time resulted in 44, 24, 21, and 38% longer roots than harvesting the crop 14 and seven-DBEM than the EM time as well as seven, 14, and 21 days later than the EM, respectively (Table IV). This might be due to deterioration of seeds during delayed harvest through infection and low-quality seeds produced at early harvest. This result was in accordance with the findings of [16] reported that in soybean the vigorous seeds give significantly higher germination, root and shoot length.

I. Seedling dry weight

The highest dry weight (3.26) was recorded for Manipintar harvested at the EM time, followed by the same variety harvested seven and 14-DAEM time (Table 5). The lowest was recorded for Bulki harvested at all stages of maturity. Manipintar harvested 21-DAEM time had a very low seedling dry weight (1.31 g). The variations observed in seedling dry weight between varieties might be attributed to genetic differences. Manipintar is morphologically vigorous having larger seed size and more robust seedlings than Bulki. That large-sized seeds establish relatively better than small-sized seeds is in agreement with work done by [19] who reported that seedlings from larger and heavier seeds utilized cotyledonary reserve at a faster rate to have a greater rate of stem elongation and accumulation of root and shoot dry weight than seedlings from small-sized seeds. There were significant differences in seedling dry weights between early and delayed harvests. This might be attributed due to low dry matter accumulation of seeds at early harvests and deterioration in seeds due to physical factors at delayed harvests. The better seed quality parameters such like a speed of germination rate index, shoot and root length, seedling dry weight and vigor index might be probably due to abundant availability of moisture, nutrition during crop growth [12].

TABLE V Main effects of variety and harvesting time on seedling dry weight, vigour index I and vigour index II of groundnut

Variety	Treatme	Parameters		
	Harvesting Time	**Seedling Dry Weight (g)**	**Vigour Index I**	**Vigour Index II**
Bulki (B)	14-DBEM	0.88ef	1580.60 g	62.65f

	7-DBEM	0.94ef	2395.60 de	78.34ef
	EM	1.26de	3430.00 b	123.96 cd
	7-DAEM	1.02de f	3143.70 c	93.44d ef
	14-DAEM	0.87ef	2319.10 de	74.71ef
	21-DAEM	0.76f	2034.10 f	61.76f
Manipintar (M)	14-DBEM	1.43cd	1642.30 g	91.60d ef
	7-DBEM	1.79c	2484.90 d	156.24 c
	EM	3.26a	3934.10 a	317.88 a
	7-DAEM	2.42b	2960.00 c	208.16 b
	14-DAEM	2.32b	2573.90 d	194.67 b
	21-DAEM	1.31de	2186.20 ef	106.78 de
LSD (0.05)		0.44	280.73	37.19
CV (%)		17.1	6.51	16.86

Means followed by the same letter within a column are not significantly different at 5% level of significance. LSD = Least significant difference; CV = Coefficient of variation; D= Days; B=Before; E= Expected; M= Maturity; A= After.

J. Vigour index I

Analysis of variance showed harvesting time had highly significant ($P < 0.01$) influence on vigor index I. The interaction effect of variety and harvesting time significantly ($P < 0.05$) influenced the vigor index I.

The highest vigor index I mean value was observed for Manipintar harvested at the EM time, closely followed by Bulki harvested at the same time of maturity. The lowest mean value of vigor index I was recorded for Bulki harvested 14-DBEM time, followed by Manipintar harvested 21-DAEM time (Table V). Thus, Manipintar harvested at maturity showed about 149% more vigor index I value over Bulki harvested 14-DBEM time. This result is in agreement with the findings of [12] who reported that higher shoot, root length, and germination could be attributed to the maximum index in groundnut.

K. Vigour index II

Analysis of variance showed that the main effect of variety, harvesting time, and the interaction effect of harvesting time with variety highly significantly ($P < 0.01$) affected vigor index II.

Manipintar harvested at the EM time had the highest vigor index II (317.88) that exceeded the vigor index II of Bulki harvested at the same time of maturity by about 156% (Table V). This was followed by Manipintar harvested seven and 14-DAEM time. The lowest vigor index II was recorded for Bulki harvested at all stages of growth except the one harvested at the EM time as well as Manipintar harvested 14-DBEM than the EM time. This result is in agreement with those of [5] who observed that vigor index was higher in large size seeds and lower in small size seeds of groundnut. In general, the higher index could be attributed to seeds having better food reserve and higher germination percentage as well as root and shoot length. This result is in agreement with the findings of [9] who reported that higher shoot, root length, and germination could be attributed to the maximum index in groundnut. Ref [9] also reported that higher seedling vigor index II was probably due to the associated effect of germination percentage and seedling length. Increased seedling vigor index II might be due to the maturation of seeds resulting in an improvement in germination percentage and seedling length.

L. Germination rate index

Analysis of variance showed that the main effect of harvesting time was highly significant ($P < 0.01$) on the mean value of the germination rate index. However, the main effect of the variety was not significant. The variety and harvesting time interacted to influence the germination rate index significantly ($P < 0.05$). Bulki and Manipintar harvested at the EM time had the highest germination rate indices. The lowest germination rate indices were recorded for both varieties in response to harvesting 14-DBEM time (Table VI). Thus, the germination rate index of Manipintar harvested at the EM time exceeded the germination rate index of the same variety, as well as that of Bulki, harvested 14-DBEM time by about 47 and 62%, respectively. This might be due to underdeveloped seeds at early harvest which did not full accumulate biochemicals which is important for germination as well as damage of seeds by biotic and abiotic factors at delayed harvest. This result agreed with [13] who indicated that seeds depend on the storage food during the course of germination until they reach independent stage growth with true leaves when they start photo-assimilation.

M. Field emergence

Analysis of variance showed that the main effect of variety, harvesting times and their interaction were highly significant ($P \leq 0.01$) on field emergence of groundnut.

TABLE VI Effects of harvesting time and variety on germination rate index and field emergence of groundnut

Variety	Treatment	Parameters	
	Harvesting Time	Germination Rate	Field Emergenc

Bulki (B)	14-DBEM	3.84h	3.07e
	7-DBEM	4.59fg	3.93d
	EM	6.34a	4.91b
	7-DAEM	5.85b	4.69bc
	14-DAEM	5.40c	4.09d
	21-DAEM	4.67ef	4.13d
Manipintar (M)	14-DBEM	4.25g	4.10d
	7-DBEM	4.95de	4.54c
	EM	6.23a	5.35a
	7-DAEM	5.46c	4.82bc
	14-DAEM	5.27cd	4.02d
	21-DAEM	4.65ef	3.95d
LSD		0.35	0.47
CV (%)		4	4.7

Means followed by the same letter within a column are not significantly different at 5% level of significance. LSD = Least significant difference; CV = Coefficient of variation; D= Days; B=Before; E= Expected; M= Maturity; A= After.

The highest mean value of field emergence of Manipintar harvested at the EM time exceeded the lowest mean value of that of Bulki harvested 14-DBEM by about 74% (Table VI). This might be due to better-stored food reserves of seeds at maturity. The superiority of the germination index was reflected by higher field emergence. The lower field emergence was related to the loss in seedling vigor. This difference in the above parameters over seed lots could be mainly due to better-stored food reserves and healthy conditions of seeds. Such variability in seedling vigor index over variation in the vigor of seed lots were also reported by [16] in soybean. Ref [14] reported that, poor quality seeds will show symptoms such as low viability, reduced germination and emergency rates.

N. Seed Health Test

The fungal genera *Aspergillusflavus, Aspergillusniger, Penicilliumspp,Alternariaspp,Phomaspp, Fusarium spp, Chaetomiumspp,* and *Sclerotiumrofsii, and* Bacteria species *Pseudomonas spp.* and *Xanthomonasspp* were detected on groundnut seed samples during the study (Table VII). There was a significant difference among varieties, harvesting times in percentage of seed samples infected. Laboratory analysis showed that among detected fungi *Penicilliumspp* was occurred at highest 9106.670 mean percentage and found to infect all the seeds sample of different harvesting times andcomparatively most of the diseases were observed on seed samples of Manipintar as compared to that of Bulki. During seed health analysis of harvesting times it was found that at early harvesting *Fusarium spp* and *Pseudomonas spp were* observed at 14and 7-DBEMat 2.2% and *Phomaspp, Chaetomiumspp, and Xanthomonasspp*were recorded at 7, 14 and 21-DAEMto 2.2%, 6.6% and 6.6 % of occurrences in Bulki respectively. WhileManipintar wasaffected by all identified fungi spp expect*Chaetomiumspp*andfew numbers of *Pseudomonas spp, and Fusarium spp* at 14 and 21-DAEMonly. None of the associated diseases attacked the groundnut harvested at expected physiological maturity except *Penicillium spp*. Generally, the higher percentage infection was recorded at delayed harvesting over early harvesting in both varieties (Table VII).

IV. CONCLUSION

For obtaining higher seed quality of groundnut, harvesting groundnut at the proper time of physiological maturity is very important. Premature harvested seeds will shrink when drying, lowering the quality of the seed. Delays in harvesting result in poor quality seed due to the development of molds as well as infections and damage by pathogens.
Delayed harvesting also resulted in drastic reductions in seed quality. Moreover, to reduce the early harvesting of groundnut in the study area merely for the sake of catching the early high local market prices, introducing an early maturing variety may be a better alternative.

In conclusion, harvesting the groundnut varieties early or late resulted in poor seed quality and health. Harvesting the crop early or late resulted in poor quality seeds having low planting values which determine the yield obtained from the seeds in the next growing season. Manipintar was less sensitivity than Bulki to deterioration in seed quality in response to hastened or delayed harvesting. However, the seed of this variety was more prone to diseases than the seed of the Bulki variety. Therefore, farmers should harvest Bulki 153 up to 160 days and Manipintar 163 days after sowing.

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REFERENCE

[1] AA Rahmianna, ATaufiq and E Yusnawan., 2007. Effect of harvest timing and postharvest storage conditions on aflatoxin contamination in groundnuts harvested from the Wonogiri regency in Indonesia. Journal of SAT Agri. Res.5(1).
[2] Adugna, W., 1992. Groundnut breeding in Ethiopia. p. 312. Proceedings of the first national oilseeds workshop in

Ethiopia. Addis Ababa, Ethiopia, 3-5 December 1991. Institute of Agri. Res.
[3] Anonymous, 2007. Farming system survey document in Assosa, Benishangul-Gumuz Regional State, Ethiopia, Assosa Agricultural Research Centre (AARC), unpublished.
[4] Anonymous, 2009. Research terminal report onsoil and water in Assosa, Benishangul-Gumuz Regional State, Ethiopia, Assosa Agricultural Research Centre(AARC), unpublished.
[5] Borate, D. N., A. D. Dumbre and M. T. Bhingarde. 1993. Effect of seed size on growth, yield and seed quality of groundnut (ArachishypogaeaL.) under summer conditions. Seed Res. 21(2): 107-109.
[6] Burn and Huffman., 1975. Groundnut agronomic and post-harvest practices training manual.
[7] DevidDayal, Ghosh PK and Ravindra V., 1999. The influence of seed maturity variations on crop establishment, growth and yield of groundnut (ArachishypogaeaL.). Trop. Agri.76:151–156.
[8] Getnet, A. and Nigussie, A., 1992. Production and research on oilseeds in Ethiopia. Proceedings of the national oilseeds workshop in Ethiopia, 3-5 December 1991. Addis Ababa: Institute of Agri. Res. pp. 312.
[9] Gore, S. V., R. B. Patil and G. R. Wankhade. 1997. Effect of maturity period and harvesting ti me on seed quality in soybean (Glycine max. [L.] Merill) cultivars. Seed Res. 25(1): 45-49.
[10] ISTA.,1993. International rule for seed testing. Seed Science and Techn.21:1-288.
[11] Kumar, V. K. K., Thakur, R. P., and Desai, S.,2001. Prevalence of aflatoxin contamination in groundnut in Tumkur district of Karnataka, India. Intern. Arachis Newsletter, 21, 37-39.
[12] Mahesh C. G. 2007. Effect of seed source growing season and genotypes on seed yield and quality of groundnut (ArachishypogaeaL.) in Dharwad. MSC.thesis. Unuvesrty of Agric. Scie., Dharwad. 80p.
[13] Pandey,S.N. And B. K. Singha, 1996. Plant phsoilogy (3rdreviesed.). Vikas Publishing house PVT LTD, New Delhi.
[14] Powell, A.A., S. Mattew and M.de A. Olivera, 1984. Sees quality in grain legumes. Advance in Applied Boilogy, 10:217-285.
[15] Rahmianna, A.A., E. Ginting, dan E. Yusnawan. 2007. Cemaranaflatoksin B1 dankualitasbijikacangtanahpadamatarantaiperdagangan di sentraproduksiKabupatenBanjarnegara.
[16] Sahoo, N.C., Mahapatra, P.K. Dixit, R.C. and Utaray, S.K. (1991). Effect of sowing date on growth, yield and quality of soyabean and groundnut. Indian Journal of Agri. Scie. 61(9):665-668.
[17] SAS, 2000. Statistical software version 9.0.
[18] Satish Kumar G. D., Popat M .N. andKanani P. R. 2008. Farmers' Perceptions of Quality of Groundnut. Journal of Inter. Agri. and Extension Educ.15 (1):48.
[19] Swank, J.C., Egli, D.B. and Pfeiffer, T.W. (1993). Seed growth characteristics of legumes differing in duration of seed fill. Crop Sci.27:85-89.
[20] Tucker, H. And L.N. Wright, 1999. Estimating the rapid germination. Crop science, 5: 398-399.
[21] Young JH and Moore RP.,1972. Factors affecting planting quality of seed groundnuts. II. Effect of harvest methods. Oleagineux27:89–93.

TABLE VII Percentage occurrences of different fungi and Bacteria on groundnut samples tested for different harvesting times

Varieties	Harvesting Ti...	Alternariaspp	Fusarium spp	Pseudomonas spp	Chaetomiumspp	Sclerotiumrofsi...	Aspergillusflav	Aspergillusn...	Penicilliumspp	Phoma Spp	Xanthomonasspp
Bulki	14-DBEM	0.71 (0)b	0.71 (0)d	(2.22)ab	0.71 (0)c	0.71 (0)...	0.71(0)e	0.71 (0)...	(6.67)g	0.71 (0)...	(6.67)a
	7-DBEM	0.71 (0)b	(2.22)bc	0.71 (0)c	0.71 (0)c	0.71 (0)e	0.71 (0)e	0.71 (0)e	(11.11)f	0.71 (0)e	(4.44)b
	EM	0.71 (0)b	0.71 (0)d	0.71 (0)c	0.71 (0)c	0.71 (0)e	0.71(0)e	0.71 (0)e	(6.67)g	0.71 (0)e	0.71 (0)c
	7-DAEM	0.71 (0)b	0.71 (0)d	0.71 (0)c	(2.22b	0.71 (0)e	0.71(0)e	0.71 (0)e	(2.22)h	(2.22)e	0.71 (0)c
	14-DAEM	0.71 (0)b	0.71 (0)d	0.71 (0)c	0.71 (0)c	0.71 (0)e	0.71(0)e	0.71 (0)e	(11.11)f	(6.67)d	0.71 (0)c
	21-DAEM	0.71 (0)b	0.71 (0)d	0.71 (0)c	(6.67)a	0.71 (0)e	0.71(0)e	0.71 (0)e	(6.67)g	(6.67)d	0.71 (0)c
Manipintar	14-	(02.22)b	0.71 (0)d	0.71 (0)c	0.71 (0)c	(13.33)d	(0.33)c	(55.55)	(13.33)e	0.71	(6.67)a
	7-DBEM	0.71 (0)b	0.71 (0)d	0.71 (0)c	0.71 (0)c	(15.56)c	(2.22)d	(64.45) a	(40)c	0.71 (0)e	0.71 (0)c
	EM	(6.67)a	0.71 (0)d	0.71 (0)c	0.71 (0)c	0.71 (0)e	0.71(0)e	(8.89)d	(32.22)d	(6)c	0.71 (0)c
	7-DAEM	0.71 (0)b	0.71 (0)d	0.71 (0)c	0.71 (0)c	(1556)c	0.71(0)e	0.71	(40)c	(102)a	0.71 (0)c
	14-DAEM	(17.78)a	(13.33)a	(4.45)a	0.71 (0)c	(17.78)b	(8.9)b	(11.11) d	(106.67) a	(85.22)b	(6.67)a
	21-DAEM	0.71 (0)b	(11.11)a	0.71 (0)c	0.71 (0)c	(40)a	(11.11)a	(17.78) c	(84.44)b	(82.22)b	0.71(0)c
LSD		2.38(11.33)	0.98(1.91)	0.37(0.27)	0.30(0.19)	0.64(0.83)	0.41(0.34)	1.73(6)	0.83(1.41)	1.14(2.58)	0.53(0.56)
Mean		1.02	1.03	0.80	0.83	1.72	0.97	1.95	3.38	2.51	1.06

Values with the same letter in a column are not significantly different at ≤ 5% level of the DMRT test; D= Days; B=Before; E= Expected; M= Maturity; A= After