Seed handling along the seed supply chain and its effect on germination, 2024.

Herman de Putter [1)], Aisha Abdulkadir * [2)], Rabiu Suleiman [2)], Abubakar Garba [3)] Aminu Haruna Gattah [4)] and Ilesanmi Pupa [5)]

Wageningen University and Research, Institute /Ahmadu Bello University Zaria, Nigeria, NAERLS/Ahmadu Bello University Zaria, Nigeria, Agric. Engineering/Ahmadu Bello University Zaria, Nigeria, Sahel Consulting Agriculture and Nutrition Limited.

COLLABORATIVE SEEDPROGRAMME Nigeria-Netherlands

Contents

Executive summary

The study carried out in 2024 investigates the factors that contribute to the deterioration of seed quality along the supply chain during handling in Kaduna and Kano states, Nigeria. It focuses on three categories of seed vendors and users: seed distributors, agro-dealers, lead farmers, and farmers. In Kaduna, the selected local government areas are Sabon Gari, Zaria, Ikara, and Makarfi, while in Kano, they are Bunkure, Bichi, Minjibir, and Kano town. We observed that farmers who received training in seed handling had extensive knowledge of seed storage compared to those who did not receive any training. The germination results showed higher germination rates from seed samples collected from both agro-dealers and farmers, whether on sharp sand or Petri dishes. This implies that seed distributors may not have adequate storage facilities to preserve vegetable seeds for extended periods, or they may have larger quantities of seeds that are not sold promptly. This low germination rate could be due to an unreliable power supply resulting in poor storage conditions. The knowledge gaps identified by the involved seed actors are: lack of knowledge regarding seed storage requirements, insufficient knowledge of vegetable market trends and forecasting, and inadequate awareness of seed regulation policies.

Introduction

The Collaborative Seed Programme (CSP) is focused on the Extension on seed and cultivation practices in Kaduna State. Kaduna State is located in Northern Nigeria, which has a large population and produces a significant portion of various field crops and vegetables (it has vast fertile land). A huge potential exists in the vegetable production sector, which is still largely unexploited. With some initiatives under the SDG to increase farmers access to information and improved skills in vegetable-crop production using best agronomic practices while using seed of high quality (high yielding, pest and disease resistant), improper handling of seeds and deployment of improved practices from seedling production to crop production remains a problem to achieving the maximum benefits from the improved varieties. This action research aimed to test the seed quality of batches along different actors in the supply chain. Also, to obtain information on the knowledge of chain actors on seed handling along the supply chain. This will be done to assess the viability of tomato and cabbage seed varieties to germination from different seed chain actors along the supply chain around Kaduna State.

The seed supply chain forms the backbone of agriculture, serving as farmers' primary source of planting material. However, this critical component of the agricultural sector faces many challenges that impede its efficiency and effectiveness. Various factors contribute to the complexities within the seed supply chain from the initial production and distribution stages to the farmers' final planting.

The action research primarily focuses on three supply chain actors to investigate possible seed deterioration along the vegetable seed supply chain and possible causes. The factors that could be associated with this are high temperature, relative humidity, and moisture in the storage environment, which seem to be the main factors involved in the deterioration of seed quality. The result of seed deterioration is the loss of germination capacity.

The seed supply chain

Seed distributors: The local companies studied in this research are involved in marketing vegetable seeds in Nigeria, specifically in Kaduna and Kano. These companies typically have different seed storage facilities based on their financial resources. They receive vegetable seeds from international suppliers, which are shipped into the country and then cleared from the seaport before being transported to the northern region for distribution to agro-dealers and farmers.

Agro-dealers: In the context of this action research, various categories of agro-dealers were interviewed about seed handling. An agro-dealer received seeds from vegetable seed distributors and stored them in-store/on shelves without cooling facilities to preserve the seeds. The agro-dealer then distributed the seeds to retailers and mobile agro-dealers using different means of transportation.

Farmers: The farmers obtain vegetable seeds from agro-dealers within the community/region and sometimes travel more than 20 kilometers to buy seeds. They usually store the excess seeds in a cool place or environment to preserve them, where the temperature conditions cannot be ascertained/guaranteed.

Research questions

The study addressed two key research questions:

Research Question 1: What is the seed quality defined by germination % at different supply chain actors.
Research Question 2: How do chain actors handle seed along the supply chain?
Research Question 3: What knowledge gap exists among the different chain actors on seed handling along the supply chain?

Methodology

For this activity, different chain actors in the supply chain of seeds from distributors to farmers in Kaduna and Kano States were visited. At each point, the storage condition was assessed, and a questionnaire was held with the seller of the seed distributors or the farmer. From selected points, seeds of cabbage (Brassica oleracea var. capitata) and tomato (Solanum lycopersicum) were collected from Seed vendors and tested for germination.

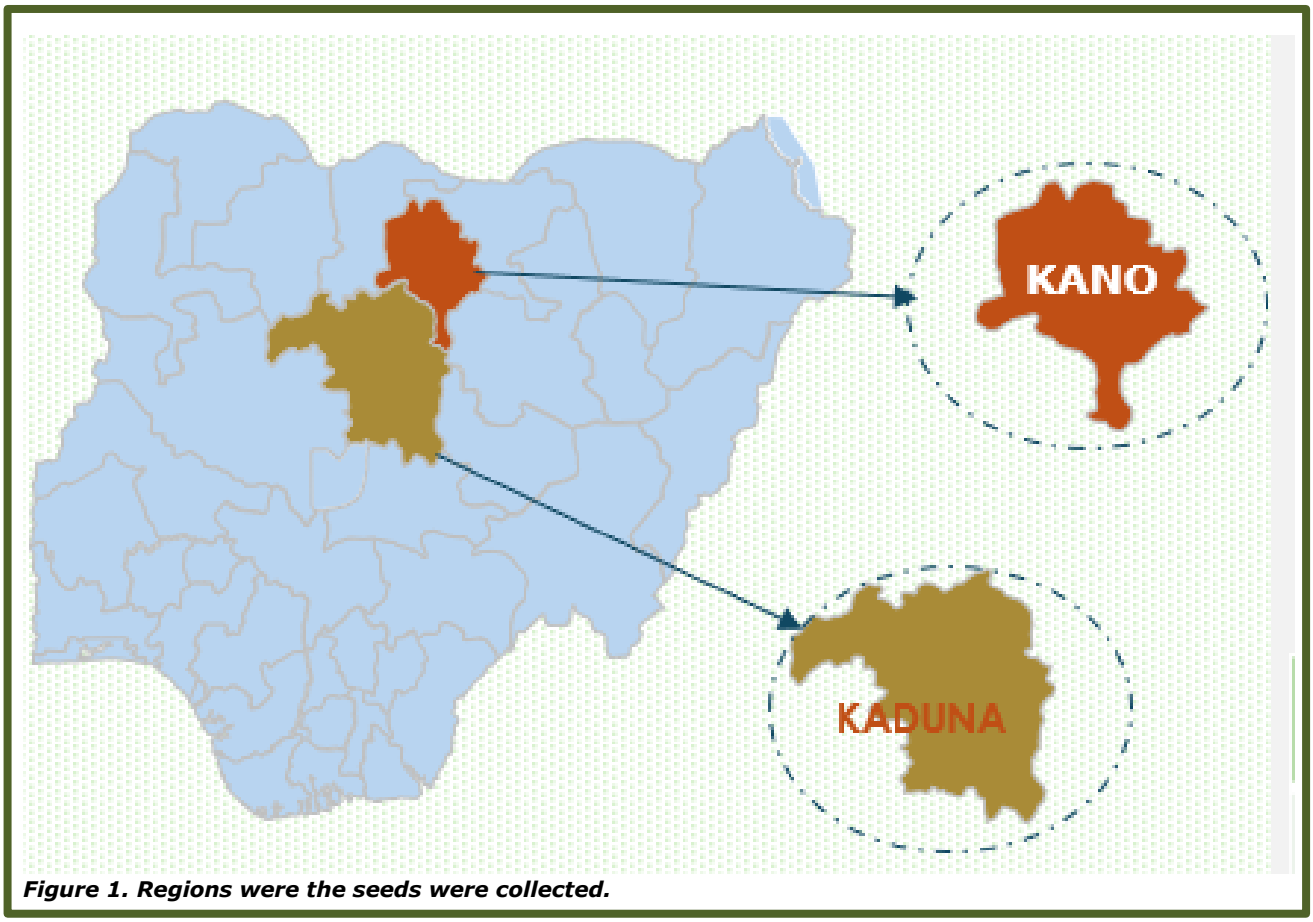


Figure 1. Regions were the seeds were collected.

The activity was conducted in 2024 with seed distributors from six (6) vegetable seed companies: East-West Seed, Enza Zaden, Hazera, Monsanto, Pop Vriend, and Rijk Zwaan.
The following six distributors selling seeds of the six seed companies were visited in the period from 19 June till 7 July to interview and to collect seeds from:

- Isah Agro and Chemicals – Kaduna
- Seedforth Agro – Kaduna
- Value seed limited – Kaduna
- Afri – Agri Product – Kano
- Onida Aquaculture – Kano
- Royal Blue Contractors – Kano

There were 5 sales points, agro-dealers, where seeds of the six selected companies were sold and visited. Five (5) farmers from Zaria (Dan Mogaji) and five (5) from Ikara were chosen, and ten (10) farmers from Bichi were interviewed for this activity. From each group, seeds were obtained. In this way, seeds were collected from a total of 14 points. The most common packages were sachets and tins. At the importers and agro-dealers, all packages were sealed tightly when collected. From two farmer groups, packages were opened, and from one group, they were still closed.

Table 1. Characteristics of cabbage seeds collected for germination tests.

Variety	Source of seed	Company	Lot/batch number	Packing date	Expiry date	Germination %	Purity %	Number of seeds	Weight of seeds (g)
Pakse F1	Royal Blue Contractors	East-West Seed	Lot:3204042/ B:3207500	1-9-2022	1-9-2025	99	98	1,000	
Pakse F1	Yusuf Bichi	East-West Seed	Lot:3204042/ B:3207500				98	1,000	
Pakse F1	Hajj. Talatu	East-West Seed	Lot:3204042/ B:3207500				98	1,000	
Taurus F1	Onida Aquaculture	Hazera	Lot:103426/ B:341073	Oct-21	-	EU	99	1,000	
Taurus F1	Adamu Kabiru	Hazera	Lot:103426/ B:341073	Oct-21	-	EU	99	1,000	
Taurus F1	Nuhu Bello	Hazera	Lot:103426/ B:341073	Oct-21	-	EU	99	1,000	
Amphion	Murtala Agro	Monsanto	B:0221223189						10
Amphion	Bala Hamisu	Monsanto	B:0221223189						10
KK Cross F1	Afri - Agri Product	Popvriend	B:5001850				99	1,000	
KK Cross F1	Alh. Aliyu Isah	Popvriend	B:5001850				99	1,000	
KK Cross F1	Abdullahi Sale	Popvriend	B:5001850				99	1,000	
Tacoma RZ	Seedforth Agro	Rijk Zwaan	Lot:102942814/ B:102976963		-			1,000	2.8

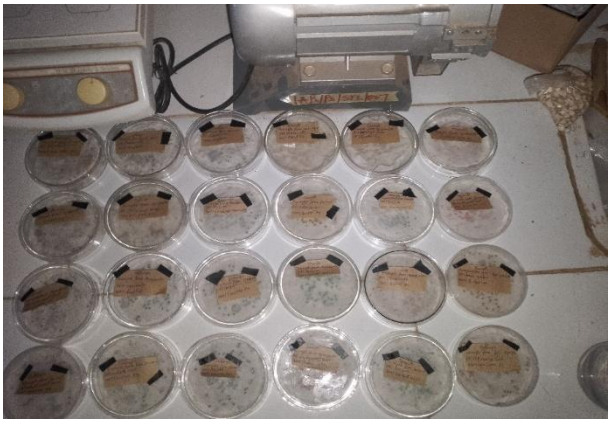
Table 2. Characteristics of Tomato seeds collected for germination tests.

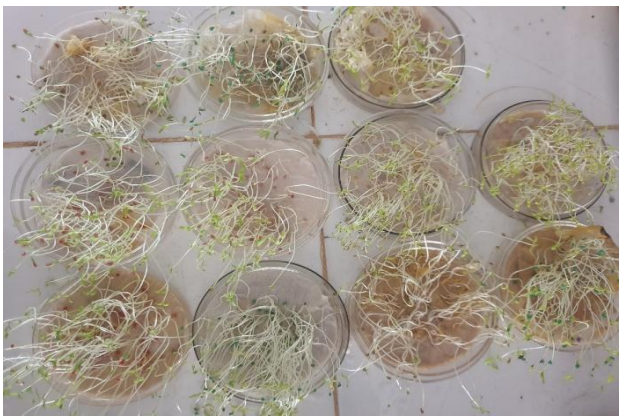
Variety	Source of seed	Company	Lot / batch number	Packing date	Expiry date	Germination %	Purity %	Number of seeds	Weight of seeds
Padma	Royal Blue Contractors	East-West Seed	Lot:4079243/ B:4465889	20-2-2024	19-2-2027	90	98		5
Diva	Hajj. Talatu	East-West Seed	Lot:2508655/ B:2578675				98		5
Padma	Yusuf Bichi	East-West Seed	Lot:4079243/ B:4465885				98		5
Batool F1	Afri - Agri Product	Enza Zaden	B:6478141				99	500	
Batool F1	Alh. Aliyu Isah	Enza Zaden	B:6478141				99	500	
Batool F1	Abdullahi Sale	Enza Zaden	B:6478141				99	500	
Shanty IMP F1	Onida Aquaculture	Hazera	Lot:116602/ B:351597	apr-22	-	EU	99	500	
Shanty IMP F1	Adamu Kabiru	Hazera	Lot:116602/ B:351597	apr-22	-	EU	99	500	
Bridget 40 F1	Nuhu Bello	Hazera	Lot:112957/ B:323022	aug-22	jun-24	EU	99	1,000	
Ansal	Isah Agro	Monsanto	B:0210775480	1 Mar 2021	Mar-23			1,000	
Ansal	Murtal Agro	Monsanto	B:0210775480					1,000	

Collected seeds were tested on germination percentage at the Department of Plant Science, Faculty of Agriculture, Institute for Agricultural Research (IAR) Ahmadu Bello University in Zaria.

The seed samples collected were each counted using a seed counting machine and then sorted based on variety and seed source.
The seed samples were tested for germination using two different media: sharp sand and tissue paper. The samples tested with sharp sand were placed in a plastic disposable plate, and the samples tested with tissue paper were placed in a petri dish.
The seed samples were planted in plastic plates and replicated thrice, with 25 seeds sown per plate. The seed samples were not replicated in the Petri dishes, with 100 seeds sown per Petri dish. Distilled water was used to soak the seeds to avoid disease infestation.
Germination counts were conducted for plastic plates and petri dishes: 3 DAS, 4 DAS, and 7 DAS. Vigour was determined based on seed germination, with higher numbers indicating higher vigor.

Results of seed germination tests





The varieties Batool F1, Shanty IMP F1, and Ansal F1 when tested with the sand germination method all exhibited high germination rates, ranging from 99% to 94%. Germination of Batool was good at seeds from Importer/dealer and agroshop but was quite lower at seeds collected from farmers. Germination of Padma seeds collected at the importer/dealer was lower than the 90% germination stated on the package while seed collected from the agro shop showed a germination of 47%. In spite of the storage at ambient temperatures at one of the dealers, germination percentage of the seeds collected at this dealer showed a germination of 82% still.

Table 3. Germination of tomato seeds with the sand test.

Variety	Importer/ Dealer	Agroshop	Farmer	Mean
Ansal	82	99		91
Batool	94	99	69	87
Bridget 40			87	87
Diva			68	68
Padma	72	47		60
Shanty	97	97		97
Mean	**86**	**86**	**75**	**83**

With the petri dish test the germination results were slightly different from the sand test results. Only Ansal showed a percentage higher than 90% with seeds collected from Importers while at the sand test Ansal performed less good. Padma showed a better germination with the petri dish test than with the sand test. Germination of seeds collected at agroshops was not lower than at the importers.

Table 4. Germination test of tomato seeds in Petri dish.

Variety	Importer/ Dealer	Agroshop	Farmer	Mean
Ansal	90	93		92
Batool	72	95	90	86
Bridget 40			93	93
Diva			80	80
Padma	78	85		82
Shanty	73	73		73
Mean	**78**	**87**	**88**	**84**

The varieties KK cross F1, Amphion, and Tacoma RZ all showed high germination percentages, ranging from 95% to 91%. These results indicate that the seed storage and handling conditions for the cabbage seed are remarkably good as they are sent from the seed distributors to the farmers. The germination rates for Pakse F1 was 71% for seeds collected from the importer/dealer and less good. Interestingly is that Taurus germination of seeds collected at the importer showed a lower percentage than the seeds collected from the agro-shop. Seeds collected from farmers showed a lower germination than the seeds collected from the agro-shop.

Table 5. Germination of cabbage seeds with the sand test.

Variety	Importer/ Dealer	Agroshop	Farmer	Mean
Amphion		94	91	93
KK Cross	94	94	95	94
Pakse	71	84	71	75
Tacoma	94			94
Taurus	44	79	68	64
Mean	**76**	**88**	**81**	**82**

Germination on petri dish was different from the sand test. KK Cross showed a lower percentage with seeds from the Agroshop while the germination of the seeds from Importer and Farmer was higher. A same result was present with Taurus. Germination of seeds collected at farmers was not lower than at the other chain actors.

Table 6. Germination test of cabbage seeds in Petri dish.

Variety	Importer/ Dealer	Agroshop	Farmer	Mean
Amphion		80	98	89
KK Cross	80	40	81	67
Pakse	33	64	70	56
Tacoma	70			70
Taurus	70	50	93	71
Mean	**63**	**59**	**86**	**69**

Results survey

Dealers have maximum 12 years' experience in handling vegetable seeds. All of them assess the market and the costs of seeds to determine the quantity of seeds required to purchase to avoid overstock. According to the dealers vegetable seeds can be kept for 2 to 3 years without any issues when stored at the right conditions. The dealers try to safeguard seed quality by having germination tests done, either by them selves or by the supplier. Next to that seeds are discarded when they exceed the date of expiry. Five dealers have a special designed cold store room to keep the seeds at optimal storage conditions. Only one dealer keeps seeds at ambient temperature where forced ventilation is used to cool down the space where the seeds are kept. All dealers are well informed about the fact that vegetable seeds should be stored at cool temperatures with low humidity. For storing seeds and how to handle them all dealers have received trainings from the seed companies of which they sell vegetable seeds. The actual observed storage situation is in line with the information provided by the dealers.

Figure 9. Agroshop at Kofar Doka, Zaria LGA.

Figure 10. Agroshop at PZ Sabon Gari LGA, note the seeds are put on display at ambient temperature and bright light conditions.

Figure 11. Storage of seeds at Isah Agro. Lago street, Sabon Gari LGA.

Figure 12. Seed storage room at Royal Blue Contractors Kano

Figure 13. Seed storage room at Royal Blue Contractors, Kano.

Figure 14. Seeds on display at an agro shop in Zaria. Note that seeds and pesticides are sold from shelves in the same space.

Figure 15. Seeds are on display at an agro shop in Bich LGA, Kano. Also, here, seeds are next to bottles with pesticides or foliar fertilizers.

Figure 16. Agroshop seed storage, note that the seeds are kept at a special refrigerator to maintain a cool temperature.

Figure 17. Seed storage in a refrigerator at Afri – Agri Product, Kano.

Figure 18. Interview with Hajiya Talatu. Kano

Figure 19. Seeds kept in a drawer at Bunkure, Kano.

Figure 20. Interview with Mal. Yusuf Bichi

Table 7. Responses of visited Importer/dealers of vegetable seeds.

Questions	**Dealer 1**	**Dealer 2**	**Dealer 3**	**Dealer 4**	**Dealer 5**	**Dealer 6**
How long experience with handling seeds?	3 years	5 years	1 year	6 years	12 years	3 years
Decision-making process on what seeds to order and how many?	Purchase cost, fluctuations in foreign exchange rates, taxes associated with seed purchase, and seed demand rates to determine the quantity to order.	Cost of seed and competitors' activities, gather market Intelligence on a variety of demands.	Price and sales review with the sales team then doing a comparative analysis, trending cost place orders based on quantity forecasted.	Looking at seed sales history to makes forecast on varieties and quantity of seed to be order.	Average request propositional to farmers requests we do projection based on request before placing order.	Make decisions in terms of cost profile, sales figures, etc. Management accounts for decision-making and documentation before placing an order for the quantity of seed.
Is there a special seed storage/what is being used as seed storage/seed storage area?	The facility used for storage is a room with a standing fan and a window for ventilation.	A fully well closed air-conditioned room with pallets and no windows with optimal temperature for seed storage.	A fully air-conditioned room and a refrigerator that has a controlled environment which also serves as a display case for customers.	A large, temperature controlled (cold) room accessed only twice every quarter. Additionally, a regulated fridge at the Kano outlet.	Yes, we are using a store with an air conditioner on a stable power source, the temperature has been regulated.	Yes, a store with an air conditioner that makes the area cool for the seed.
What requirements should a seed storage place have according to the interviewee?	Have a cooling system that can be regulated, aerated, and palates	Have a well-regulated cooling system and devices to detect temperature and relative humidity levels	Adequate storage space, the refrigerator temperature should be regulated to the minimum level, and well airtight, and the seed should be placed above the floor.	Have a cooling system that the temperature can be regulated, monitored regularly. Seeds should be stored based on crops and variety in plastic crates available to	Standard storage should have folin material in a carton with seed arranged in it, reduces humidity through the use of drying agents, it should have good cross ventilation.	Stable electricity, cooling system, thermometer, temperature regulator, shelves, and pallets.

				pick seed pouches.		
Has he/she ever been informed/trained on how to handle seeds?	Yes, internal training was conducted by the company on how to safely handle seeds.	Yes	Yes, one of our staff was trained by EWS on seed handling.	Yes	Yes, by Hazera and Onida	Yes, Internal training by Seedforth Agro
How long is it possible according to the actor to store seeds?	2 – 3 yrs	2 – 3 years	2 - 3 years	2 years	2 years	2 - 3 years
Discarding seeds ever done when assumed they are no longer viable?	Yes, we usually remove from our sellable inventory and burn	Yes	Yes, we discard the seed through our out-grower program, while farmers pay the cost in kind.	Discard seeds that are not viable	Yes, some time return the seed to Hazera for replacement	Yes, we discard
Does a chain actor perform a germination test?	No	Yes, from each lot/batch	Yes, but through the seed company and by customs officers at the import clearing process.	Yes	Yes, before distribution to the market	Yes, done from Seedforth headquarters
Conditions of the place where the seeds were kept described by the enumerator	Mini showroom where vegetable seeds are kept on a shelf, and the main stocks are stored in a room with a normal room temperature of 28-34°C. Additionally, there is a standing fan and a window for cross ventilation.	The store looks great with bright white LED bulbs. The vegetable seeds are well organized based on crop, variety, and FIFO. Tally cards are kept beside each stack.	The store is equipped with air conditioning and adequate lighting. The products are neatly arranged based on crop and variety, and there is a deep freezer and space for the storekeeper.	It is a fridge, and the seeds are stored in while some of the seeds that could not fit into the fridge are stored in a container where there is a cooling system.	A room with an air condition fully stocked with vegetable seed	Shelve, cooling system, bright light, cross ventilation and pallets.
Actual Light	The light in the store is deemed not so bright.	Bright white LED bulb	Very deemed light	Normal brightness	Deem light	Bright light
Actual Temperature	Room temperature - 28-34°C	16°C	16°C	Ideal fridge temperature for seed	16 to 20°C	Optimum temperature suitable for vegetable seed storage

Agroshop owners are of the opinion that seeds can be stored only for 1 to maximum 3 years. The question on the duration or turnover period for seeds was misunderstood and instead the owners gave an indication on sales turnover. According to the agro shop owners farmers do know about quality seeds and have a demand for them. Fake seeds are an issue in Nigeria and the visited agro shops take action to prevent fake seeds entering the market.

Storage of seeds at agro shops is in all observed cases at standard ambient temperature and in full sun light. Most owners do realize that this is not preferred and know that seeds are best kept at cool temperatures.

Table 8. Responses of visited Agroshops of vegetable seeds.

Questions	**Agro shop 7**	**Agro shop 8**	**Agro shop 9**	**Agro shop 10**	**Agro shop 11**
Where is the most common source to obtain seeds from?	I obtain my vegetable seed from Afri – Agri Product distributors, Value seeds, Isah Agro and Jubali.	Royal Blue Contractors	Royal Blue Contractors and Syngenta	Sa'adatu Rimi, Jubali and Griffaton	Value seed, Isah agro, Jubali, Afri - Agri product, and Technism
What is the average turnover period of seeds?	#560,000	#890,000	#1,000,000	#345,000	#3,000,000
To the best of your knowledge, how long can seeds be kept?	Vegetable seeds can be stored for a short time, 2 years maximum.	1 year	2 year	3 year	2 year
Do farmers have seed preference? From which company?	Yes, Farmers prefer seed from Griffaton and Stark ayres.	Yes, Farmers prefer seed from East West seed.	Yes, Farmers prefer seeds of cabbage; Nuzaka, Onions; Supaer Yali, and tomato; Platinum F1 from East West seed.	Yes, Farmers prefer seeds of tomato; Platinum F1, UC82B, Rio Grande, Diva and Padma, Cucumber from East West seed, and Griffaton.	Yes, Farmers prefer seeds of tomato; Platinum F1, UC82B, Rio Grande, UTC, Cucumber from East West seed, Griffaton, and POP Vriend.
What variety is it and how was the performance?	Tomato; POP vriend (UC82B)/ Cucumber; Griffaton (Marketmore) and POPvriend (Marketmore OP)	Diva, Platinum F1 and the germination and vigour is quite impressive. Germination; 97% and 98%	Nuzaka, Padma, Platinum F1, Super Yali – performance impressive and high yielding.	UTC, UC82B farmers preferred these varieties due to good germination %, drought tolerance, and high yielding.	Tomato: UTC, UC82B. Rio Grande, Platinum, and Padma. Cucumber; Marketmore, point setter, cabbage: Pakse, Nuzaka, and Gloria are farmers' most preferred varieties for it high yield.
How knowledgeable farmers are on seed?	Farmers are more knowledgeable on the varieties and companies they preferred based on their experiences cultivating the seed.	Farmers are knowledgeable on quality seed from the leaf and flowering.	Farmers are knowledgeable about quality seed	Farmers are knowledgeable about quality seed	Farmers are knowledgeable about quality seed
What is done to avoid fake seeds?	We ensure our seed are being supply from reputable distributors/seed companies that are duly register under the Nigeria law.	Getting seed from registered seed sources like seed distributors, seed companies and agro-dealers.	Branding of the logo can be used to prevent the sales of fake seeds, seed sources or outlets should be registered.	Create awareness among farmers on how to identify registered agro-dealers, seed packs of registered product, and the use of seedcodex.	All seed packages should come with seed codex, batch, and lot number for easy tracking, seed distributors should be visiting agro-dealers and the wider market to monitor their products on a timely basis.
How seeds should be stored as to the owner	Vegetable seeds preferably should be store under the shade were the temperature is ideal.	Store in the freezer, at room temperature, for already used seed pouches wrap them in a paper envelop before storing in a cool place.	Store under room temperature	Cool closed area with room or regulated temperature.	Seed should be store in a cool area with room or temperature or where there is an air conditioner to preserve the seed for a longer time.

Actual light or temperature condition of the shop/stall	Normal light radiation from the sun, no electric bulb in the shop norm fan. The temperature is at room temperature.	No light from the room except light radiation from the window, the temperature is normal room temperature of 28 - 34^{0}C.	Bright light and room temperature	Bright light and room temperature	Bright light from the sun's radiation and room temperature

Interviewed farmers also mentioned that seeds should not be stored for more than 3 years. Also that optimal storage is at a cool dark place. Farmers claim they are knowledgeable about quality seeds and they prefer hybrid varieties in most cases. However, Rio Grande and UC82B are OPV varieties but proven to perform in tropical areas.
Agro shops are not close by to 2 groups of the interviewed farmers. Farmers need to travel 10 to 20 km to buy seeds. The third group has less traveling distance to the agro shop and has also made arrangements for supplies with the agro shop. Fake seeds are avoided by making sure that seeds are bought from a reliable source and checking the package.

Table 8. Responses of visited Farmers using vegetable seeds.

Questions	**Farmer group 12**	**Farmer group 13**	**Farmer group 15**	**14 Farmer/agro shop**
To the best of your knowledge, how long can seeds be kept?	2 - 3 years	3 years	3 – 4 years	2 years
How seeds should be stored/is stored	Seed should be store at room temperature, absent of sunlight, no moisture and not closer to source of heat.	Seed should be stored in a cool place with optimal room temperature.	Seed should be stored in a cool place and free from moisture	Seed should be stored in a cool place with optimal room temperature and not a place with very high temperature.
How knowledgeable farmers are on seed	Farmers are knowledgeable about quality seed	Farmers are knowledgeable about quality seed	Farmers are knowledgeable about quality seed but still need more exposure on quality seed.	Farmers are knowledgeable about quality seed
Do farmers have seed preferences? From which company?	Yes, Farmers prefer seeds of tomato; Platinum F1, UC82B, Rio Grande, from East West seed, Griffaton, and POP Vriend.	Yes, Farmers prefer seeds of tomato; Platinum F1, UC82B, Platinum, from East West seed, Jubali, Stark aryes, Cabbage:Amphion, King of King F1, Gloria POP Vriend, Seminis, East West seed and Jubali.	Yes, Farmers prefer seeds of tomato; UC82B from Jubali, Technism and Stark aryes, Cabbage: Gloria, Seminis, Auxillus from Jubali and Bayer.	Yes, Farmers prefer seeds of tomato; Platinum F1, from East West seed
What is the distance of seed vendors from your community?	12 km	20 km	Kano market; 35 km	2 km (most cases we request and we are being supplied).
How can you avoid fake seeds?	We make sure we buy seed from the agrodealers or seed vendors we are familiar with.	By not buying seed from vendors that we are not familiar with. Abstaining from seed vendors that have no stable outlets.	No response	Buying seed directly from seed company
What is the signal that makes you feel a seed is fake?	Broken package, logo, packaging design.	If a seed package does not carry seed codes, broken packages, no contact address or phone number on seed package.	If the seal of the seed package is broken and the name of the company is different from the one we know.	From the packages, the logo, the information on the seed packages; like germination %, purity, number of seeds, lot and batch number.

Where is the most common source to obtain seeds from?	Jubali, Agro-dealers and East-West Seed International	Agro-dealers shop and seed companies outlets/hubs.	Agro-dealers shops	Agro-dealers shop, and registered seed distributors for East West Seed International.

Knowledge gap identified in the seed supply chain

In seed supply chains, there are various actors involved, from seed producers to farmers, each with distinct roles and responsibilities. Knowledge gaps among these actors can lead to inefficiencies, reduced seed quality, and ultimately lower crop yields. Here are some common knowledge gaps that may exist:
Local seed distributors and agro-dealers may not fully understand the importance of vegetable seed storage conditions, such as temperature and humidity control, which can lead to seed deterioration during transportation, storage, and sales. In most cases interviewed dealers mentioned that storage conditions are important and could indicate the recommended conditions but the real situation was different from it.
Farmers often have limited knowledge about proper seed storage and seedling raising before planting, leading to poor emergence rates and lower yields in spite of good germination rates of the bought seeds.

Regulatory Compliance
Producers, distributors, and agro-dealers might lack sufficient knowledge of local and international regulations regarding seed production, labeling, and distribution, which could result in legal issues and potential market losses.

Market Trends and Demand Forecasting

Producers: May have limited insight into market trends, leading to the production of seeds that are not in high demand.

Distributors: Might not have accurate demand forecasting tools, resulting in either overstocking or understocking, which can affect seed availability and lead to seed distributors manipulating the expiry date on seed packages.

Conclusions

The storage conditions at the dealers are slightly above these recommendations but still acceptable. Recommended optimum storage temperature for long-term storage of vegetable seeds is between 5 and 10oC at relative humidity levels lower than 40%. For short-term storage temperature between 2 and 15oC and relative humidity lower than 60% is recommended. In most cases, the germination of seeds is quite good at dealer and agro shop level. A germination percentage of more than 90% is recommended for vegetable seeds. A few varieties showed some lower germination results but due to the small sample size it is not possible to draw conclusions on the cause. The low germination can be caused due the original variety batch which had already a low germination as well as by the handling that reduced the germination more. However, it proves that germination tests at the importer or dealer level from randomly selected batches can be useful to prevent such batches from entering the market rather than relying only on the tests run at main offices from where the seeds are shipped. The time between sending and receiving the seeds at the final destination can be long sometimes and also during the logistic process seeds may not be always kept at optimal conditions.

The agro shops in this test have reasonable knowledge about seeds and storage of the seeds. The main challenge is the equipment to store the seeds properly. Most of the owners do know what the optimal storage conditions are but store the seeds just on simple shelves or in cupboards where seeds are exposed to high temperatures and bright sunlight.

For vegetable seeds it is best to use immediately all purchased seeds. Farmers should not keep treated seeds since the insecticide or fungicide can decrease the germination over time due to its toxic properties. In one case an open package was collected from farmers. Once opened the lifespan of seeds will decrease faster than that of seeds in a closed package. Nevertheless, germination of seeds collected from farmers was quite good still.

Recommendations

The test was done with a limited number of suppliers and farmers. Initial results shows that germination percentage of seeds collected at farmers level are quite good. To investigate further it is recommended to collect at a large scale seeds from farmers or perform tests with them immediately after they have purchased the seeds or 3-4 weeks before actually sowing in the fields. The sand test seems a better performing test and mimics better the sowing conditions in the field in nurseries or in trays.

For the different actors in the supply chain recommendations to improve or maintain current high quality standards are:

Quality Control and Certification Agencies

- **Inspection and Testing:** Seeds should be periodically tested for germination rates, moisture content, and purity. Certification agencies should inspect seed batches to ensure compliance with regulatory standards, issuing certifications for approved seeds.
- **Monitoring:** Agencies should monitor seed handling practices along the supply chain to ensure that quality is maintained and that seeds are accurately labeled and distributed.

Regulatory Bodies

- **Regulation Enforcement:** Regulatory bodies should enforce laws and standards related to seed quality, labeling, and distribution.
- **Training and Support:** should provide training and support to seed producers, agro-dealers, and farmers to ensure that best practices in seed handling are followed.

Seed companies/importers/dealers

- **Seed Treatment (if not pre-treated):**

  To avoid **f**armers treating seeds before planting to protect against soil-borne pests and diseases it is best that seed companies coat seeds. This can include coating seeds with fungicides, insecticides, or biological agents. The coated seeds are less dangerous to handle by farmers than own treated seeds. More important is that seed companies have better knowledge on what actual should be used as an agent to ensure proper protection against a specific pest or disease and at the same time have a good germination still.

- **Packaging:**
  - Seeds should be stored in moisture-proof, temperature-friendly containers or bags to protect them from environmental factors such as humidity and temperature changes.
  - The packaging should also include labeling with important information such as variety, germination rate, treatment details, batches/lot numbers, production guide, and expiration date.
- **Storage:**
  - Processed seeds should be stored in controlled environments where temperature, humidity, and light are managed to preserve seed viability. The duration of storage may vary depending on the type of seed, with some seeds requiring cold storage to maintain viability.
  - Seeds transported by sea should be provided with good storage conditions and should be properly monitored at seaports before clearing.

Distributors and Retailers

- **Transportation:**
  - Seeds that need to be transported from storage facilities to agro-dealers stores, distribution centers, or retailers should be under controlled conditions to prevent damage from heat, moisture, or physical impact.
- **Storage and Display:**
  - Distributors and retailers who store seeds on shelves or in an open environment should avoid exposing them to extreme temperatures, direct sunlight, and high humidity. Retailers should display the seeds in a manner that maintains their quality until they are sold to farmers or end-users.

Farmers

- **Variety selection:**
    - Business starts with selecting the right variety for the right purpose. Not only should information about potential yields be checked but also other characteristics like resistance or tolerance against pathogens and climatic conditions should be evaluated to make sure the variety will perform.
- **Seedling raising:**
    - Quite often complaints are heard about poor germination of seeds when actual the complaint is about poor emergence. Reputable seed companies make every effort to ensure and guarantee high germination rates of the seeds. However, if seeds are not sown properly and taken care of in a good way during the seedling raising stage emergence can be poor still. Seeds should be sown at the optimal time and depth, using methods that ensure proper seed-to-soil contact for germination. Farmers should follow the recommended practices for spacing, irrigation, and soil preparation to maximize germination and plant growth.

Annex: Information of visited actors

Distributor/importer						
Company	Isah Agro (Distributor for Bayer/Monsanto B.V)	Value Seeds Limited (Stark Aryes)	Royal Blue Contractors (East-West Seed International)	Afri – Agri Product (Enza Zaden)	Onida Aquaculture (Hazera B.V)	Seedforth agro (Rijk Zwaan)
Date	19 June	19 June	2 July	2 July	3 July	6 July
Name	Yusuf Sharafadeen	Rose John	Nasir Hassan Aliyu	Daniel Gabriel	Franklin Bala	Joseph Ekute
Position		Marketing Officer	Sale Representative	Sales rep	Marketing Officer	Marketing Officer
Location	Sabon gari Zaria	Baggadi, Kudan	Kano	Kano	Kano	Kaduna
Type of package	Sachet and tin (can)	Tin (can)	Sachet and Tin (can)	Sachet	Sachet and Tin (can)	Sachet
Condition of the package	Sealed	Well-sealed	Sealed	Sealed	part faded	Sealed
Date of seeds obtained	June, 2024		Jan – Feb, 2024	June, 2024	December, 2023	December, 2023
Agroshop						
Name	Murtala Agro	Hajiya Talatu	Yusuf Bichi	Musa Haruna	Ubadawaki	Women Self Reliance Global Farm
Date	19 June	2 July	3 July	3 July	27 June	1 July
Location	Kofar Doka, Zaria	Bunkure, Kano	Bichi, Kano	Bichi, Kano	Kofar Doka, Zaria, Kaduna	Zaria city, Kaduna
Type of package	Tin (can)	Sachet	Sachet	Sachet and Tin (can)	Sachet and Tin (can)	Sachet and Tin (can)
Condition of the package	Sealed	Sealed	Sealed	Sealed	Sealed	Sealed
Date of seeds obtained	December 2023	June, 2024	June, 2024	February, 2024	June, 2024	
Farmers						
name	Group of farmers at Danmogaji	Group of farmers at Ikara	Group of farmers at Bichi			
Date	27 June	29 June	26 July			
Location	Danmogaji, Zaria, Kaduna	Ikara town, Kaduna	Danmogaji, Zaria, Kaduna			
Type of package	Sachet and Tin (can)	Sachet and Tin (can)				
Condition of the package	Opened	Opened				