



**NAMIBIAN  
AGRONOMIC BOARD**

Constituted by Act 20 of 1992

**Contact Details:**

Tel office: +264 61 379 500  
Fax office: +264 61 22 5371  
E-mail: nabdesk@nab.com.na  
Website: www.nab.com.na

**Physical address:**

Agricultural Boards' Building  
30 David Hosea Merero Road  
Windhoek  
Namibia

**Postal address:**

PO Box 5096  
Ausspannplatz  
Windhoek  
Namibia

Creating a marketing environment that is conducive to growing and processing crops in Namibia

**AGRONOMY AND HORTICULTURE MARKET DEVELOPMENT DIVISION**

**RESEARCH AND POLICY DEVELOPMENT SUBDIVISION**

**ADAPTABILITY OF FRENCH POTATO VARIETIES IN NAMIBIA**

**2<sup>ND</sup> TRIALS FINAL REPORT**



Skin Colour: Yellow  
Flesh Colour: Whitish-Yellow  
Tuber Shape: Long-Oval



Skin Colour: Yellow  
Flesh Colour: Whitish-Yellow  
Tuber Shape: Short-Oval



Skin Colour: Whitish-Yellow  
Flesh Colour: Whitish-Yellow  
Tuber Shape: Short-Oval



Skin Colour: Yellow  
Flesh Colour: Yellow  
Tuber Shape: Long-Oval



Skin Colour: Yellow  
Flesh Colour: Yellow  
Tuber Shape: Short-Oval



Skin Colour: Yellow  
Flesh Colour: Whitish-Yellow  
Tuber Shape: Long-Oval



Skin Colour: Yellow  
Flesh Colour: Whitish-Yellow  
Tuber Shape: Long-Oval



Skin Colour: Whitish-Yellow  
Flesh Colour: Whitish-Yellow  
Tuber Shape: Round

**2021**

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## ABSTRACT

After the first trial of French potato varieties' on-farm trials concluded in May 2021, a second trial was conducted between May and September 2021 to validate the first results. The purpose was to assess the adaptability of six French potato varieties to the Namibian environment and soil conditions, namely; Barcelona, Montreal, Nicola, Rainbow, Satis, and Spunta. Two local varieties – Mondial and Tyson – were used as standard (check) varieties in the trials. Due to the prevalence of frost in some areas, these trials were only conducted at four out of seven horticultural production zones in Namibia, namely; North Central, Karst, Kavango, and the Zambezi, with 13 trial sites in total. The size of each trial was dependent on the space availability and affordability of inputs by the participant farmer. The results of the trials are therefore averaged and reported according to horticultural production zones. Kavango and Zambezi production zones did not fully succeed in this trial due to unforeseen production practice challenges. The yields were far too low compared to that of Karst and North Central production zones.

Hence, most of the yield-related conclusions and recommendations were based on these two successful production zones. A representative sampling method was used to select the plants that were harvested during and post-harvesting data collection. Two (2) meter portions times five (5) were sampled per potato variety at each trial site for recording the number of plants, several tubers for each category (<3.5mm, ≥3.5 mm to ≤ 5mm and >5mm), the weight of tubers of each category (<3.5mm, ≥3.5 mm to ≤ 5mm and >5mm) and shape of tubers for each variety. Few tubers from each variety per production zone were also sampled for dry matter content analysis. Inspections were also done to identify any climate, pests, diseases, and/or deformity effects on tubers for each variety. American leaf miner pest was identified at one trial site in North Central and Early Bright disease at one of the trial sites in the Zambezi, but no severe damages. Tuber deformity (cracking and misshapes) was observed on rainbow variety at one trial site in the Karst production zone, whereas another trial site in the Karst production zone was affected by frost, which recuperated at the later stage. Barcelona (67 tons/ha), Montreal (61 tons/ha), Spunta, and Rainbow both 51 tons/ha are the most recommendable varieties for Namibia, mainly because of high yields. Both Barcelona and Montreal yielded more than Mondial (check variety) which had 60 tons/ha. Nicola 45 tons/ha and Satis 39 tons/ha, are the only French varieties that yielded below Tyson (check variety) which had 46 tons/ha.

Furthermore, Montreal is the only variety that obtained a gross average yield in Namibia (61 tons/ha) greater than the average yield obtained in France (55 tons/ha), as well as the net yield equivalued to its net yield weights in France (weight of +50mm tubers only). The rest of the French varieties performed below their average gross yields in France but discrepancies are minimal for Barcelona, Spunta, and Rainbow varieties. In terms of net weight (total weight – the weight of tubers less than 50mm), discrepancies are as follows; Barcelona 9%, Spunta 30%, Rainbow 36%, Nicola 31%, and Satis 39% lower in Namibia, relative to net yield weights in France. Dry matter content was between 19% and 24%, making all varieties to be within the dry matter content acceptable in potato industries, which is 15% to 25%. Tubers harvested from trials in Namibia have a higher dry matter content, relative to those harvested in France.

As in congruence with first-round trials' recommendations, the adoption of French varieties, mostly Barcelona, Montreal, Spunta, and Rainbow is recommended, to complement the local varieties that are normally imported from South Africa.

**Keywords:** French potato varieties, local/check varieties, tubers, yield, weight, dry matter content, NAB

## 1. INTRODUCTION AND BACKGROUND

The Namibian Agronomic Board (NAB) in collaboration with Comptoir du Plant, The Embassy of Namibia in France, and The University of Namibia (UNAM) embarked upon a joint project that is testing the adaptability of French potato varieties to the Namibian environment and soil conditions. In early December 2020, Comptoir du Plant donated about 30kg of Six (6) French potato varieties to the NAB. These Potato trials were planted at four (4) different trial sites (farms) in Central and Karst production zones and gave positive results. Again, in April 2021, NAB received 25T of the same French seed potato varieties from Comptoir du Plant for conducting longitudinal testing of the French potato varieties. This 25 tons consignment was successfully planted at 13 different sites at Karst, North-Central, Kavango, and Zambezi production zones. The identified participating farmers are those that have a functional irrigation system, piece of arable land, and expressed to voluntarily cater for production input costs themselves and have no or limited chances of extreme low temperatures and/or frost, considering that the seed potatoes arrived towards winter, whereas potato is a warm-season crop. The French potato varieties were in the following quantity of bags weighing 25kg each – Rainbow (750 bags), and 50 bags for each of Barcelona, Montreal, Spunta, Satis, and Nicola. Thirty-two (32) bags of check varieties were also obtained by NAB from South Africa, these are Mondial and Tyson (referred to as standard or local varieties).

Trials undertaken seek to address the challenge of limited access to quality and affordable seed potatoes in Namibia, through the identification of more potato varieties suitable to Namibia's climatic and soil conditions. This would create an opportunity for producers to have access to a wide range of seed potato varieties suitable to their soil types and climatic conditions with high yield and less susceptible to pests and diseases. Despite that the seeds arrived towards winter, potato being a summer crop, the trials were successfully planted, harvested during September 2021, and with a good yield at Karst and North Central horticultural production zones. Unfortunately, Kavango and Zambezi horticultural production zones did not obtain presentable yields due to unforeseen failure to fulfil maximum potato production practices.

NAB witnessed commendable yields across varieties, both in terms of quantities and quality, especially Barcelona and Montreal outperformed Mondial (check variety). Though they are outperformed by Mondial, Spunta and Rainbow also yielded commendable yields. There were no bigger differences in terms of skin colour, flesh colour, and tuber shape between French potato varieties and check varieties that are traditionally planted in Namibia. On another occasion, the potatoes harvested from various production zones underwent a dry matter content analysis process, which has also shown positive results. Yields obtained in France for these particular varieties were compared to those yields obtained in Namibia, of which Montreal yielded more in Namibia, while discrepancies for other varieties were also minimal, especially for Barcelona.

Besides the yields and dry matter content in the tubers, other parameters observed on trials were frost, diseases, and pests. There were no major fatalities observed on the trials. Except for the American leaf miner pest, Early bright disease, tuber deformities, and frost, each was observed at one but different trial sites but was kept under control. It was therefore recommended for Namibian potato growers to further embrace sourcing seed potato from France, provided that the purchase price and transportation costs are in a feasible range, as they fluctuate and are affected by currency exchange rates. Barcelona, Montreal, Spunta, and Rainbow are the commendable French varieties as far as the current and first trials are concerned. Further trials on the potato varieties and seed potato multiplication are highly recommended.

## 2. PROBLEM STATEMENT

Potato is a staple fresh produce food and it is highly consumed in Namibia (NAB, 2021). As stated in NAB's annual reports, potato consumption accounted for more than 33 000 tons traded in the formal market, of which only about 10 300 tons were locally produced, leaving more than 23 000 to imports during the 2018/19 marketing period. Despite being the highest consumed horticultural crop in Namibia with about 39%, potato farming remains a challenge especially in terms of access to agricultural inputs and value addition. Availability and access to good quality seed potato especially by smallholder producers remains the biggest challenge and has affected local potato production. Potato breeding in Namibia is non-existent as seed potatoes are sourced from seed-producing companies in South Africa, which is another costly exercise. Large commercial growers have also expressed concern about a limited supply of seed potatoes from South Africa during the period of February to May each year, due to South African seed-producing companies prioritising the locals first.

During the last quarter of the 2020/2021 reporting period, NAB conducted seed potato trials on small plots, of which the result came out positive but required longitudinal research evidence to validate such results. Hence, this second round but a larger consignment of seed potato trials seeks to validate the results obtained from the first but smaller trials. As stated in the previous report, the main purpose is to address the challenge of limited access to quality and affordable seed potatoes in the country through the identification of more potato varieties suitable to Namibia's climatic and soil conditions. The trials would also open opportunities for investors for the establishment of tissue culture laboratories and/or greenhouses for potato breeding and supplying seed potatoes. This development will not only improve local potato production but will also create job opportunities for the locals thus improving the local economy.

## 3. OBJECTIVES

- To assess the adaptability of six (6) French potato varieties to the Namibian environment and soil conditions.
- To compare the performance of the French potatoes to local potato varieties on yield.
- To assess the internal and external qualities of the French potatoes versus local potato varieties in terms of color and dry matter content.
- To give recommendations to producers on best performing varieties based on the above parameters.

## 4. SIGNIFICANCE OF THE STUDY

This potato trial's results enable access by Namibian farmers to high-quality seed potato varieties of which suitability for Namibian soil and climatic conditions are tested. These, in turn, increase potato production in the country. The potato trials avail relevant information that will trigger domestic and foreign investment into the potato value chain. Recommendations on this study could also aid policy interventions that could facilitate the increment of local potato production.

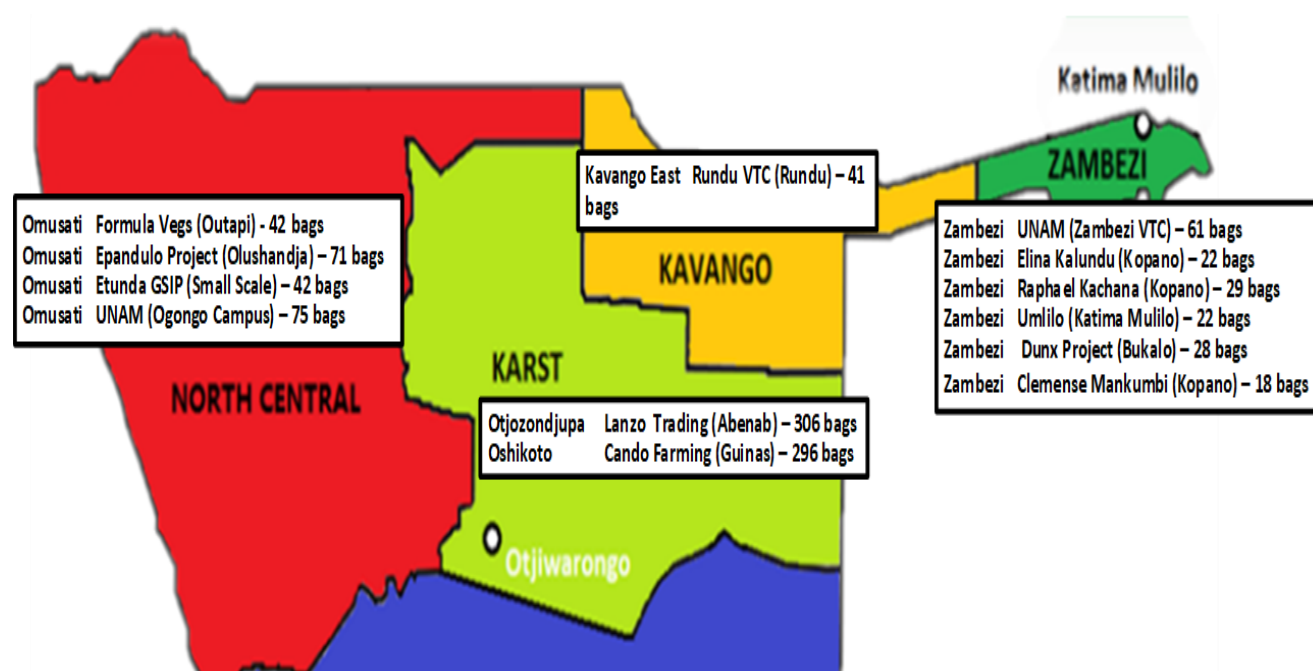
## 5. RESEARCH METHODOLOGY

The study is primarily of a trial (testing) nature, where six (6) French potato varieties were tested for adaptability to the Namibian soil and climatic conditions. The quantities of seeds used in the entire project for each variety were packaged in 25kg bags and as follows; Rainbow (750 bags), Barcelona (50 bags), Montreal (50 bags), Spunta (50 bags), Satis (50 bags), and Nicola (50 bags). Whereas, the South African varieties (32 bags) comprised of Mondial and Tyson.

The size of trials was therefore dependent on the field space and affordability of inputs by the farmer. Thirteen farms have participated in these trials with different areas planted and several seeds per variety thereof and as indicated in Table 1 hereunder. Ultimately, four production zones have participated as shown in Figure 1.

**Table 1:** List of participant growers with the respective number of bags received per variety

Farm Name (Production Zone)	NUMBER OF BAGS ALLOCATED PER VARIETY PER TRIAL SITE								The total number of 25kg bags allocated.
	Rainbow	Barcelona	Montreal	Satis	Nicola	Spunta	Mondial	Tyson	
Formula Veggies (North Central)	29	2	2	2	2	2	2	1	42
Ebandulo Project (North Central)	29	2	2	2	2	2	2	1	42
Etunda GSIP: Small Scale (North Central)	29	2	2	2	2	2	2	1	42
UNAM (Ogongo)	74	5	5	5	5	5	4	1	104
Lanzo Trading (Karst)	221	15	15	15	15	15	7	0	306
Cando Farming (Karst)	221	15	15	15	15	15	0	0	296
UNAM (Zambezi)	44	3	3	3	3	3	2	0	61
Kopano 1 (Zambezi)	15	1	1	1	1	1	2	0	22
Kopano 2 (Zambezi)	22	1	1	1	1	1	2	0	29
Umlilo (Zambezi)	15	1	1	1	1	1	2	0	22
Dunx Project (Zambezi)	4	1	1	1	1	1	1	0	10
Kopano (Zambezi)	18	0	0	0	0	0	0	0	18
Rundu VTC (Kavango)	29	2	2	2	2	2	2	0	41
	<b>750</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>50</b>	<b>28</b>	<b>4</b>	<b>1032</b>



**Figure 1:** Distribution of seed potato trials at four (4) production zones in Namibia

Table 1 above presents the number of 25kg bags of seed potatoes allocated per variety and trial sites. In addition, Figure 1 above illustrates the approximated locations in the map of Namibia, where the seed potatoes were distributed in relation to quantities given per participant grower. During the harvest of the potato trials at each trial site, data such as yield (weight and number of tubers), tuber size, tuber shape, and skin colour were captured. The potatoes harvested from each production zone were further subjected to the experimentations of dry matter content analysis. Occurrences of frost, pests, and diseases were also observed during the growth of potatoes under trials.

## 5.1 Trial Design

The seed potatoes were planted in a succession order, with check varieties planted at the marginal rows. Seeds of one variety were planted in rows until finished, before beginning to plant the rows of the next variety. As shown in Table 1 above, the rainbow variety had more seeds, hence more number rows than all other french and check potato varieties. The trial design has therefore comprised of 8 varieties, namely; six (6) French potato varieties and two (2) South African potato (check) varieties. Rows for each variety were marked with plant markers.

## 5.2 Population and Sampling Strategy

The trial population was eight seed potato varieties planted at four horticultural production zones, where thirteen (13) trial sites were established. Seed potato varieties included Rainbow, Barcelona, Montreal, Satis, Nicola, and Spunta as French potatoes, plus two local (South African) varieties, namely; Mondial and Tyson that were planted as standard varieties for benchmarking purposes. Due to the scarcity of local seed potatoes in Namibia, this study could not use similar standard varieties at all four sites. Therefore, some of the sites did not have Tyson. The standard varieties were planted at marginal rows of trials. A representative sampling method was applied to select the plants that are harvested for during and post-harvesting data collection.

Ten (10) meter rows of plants were therefore harvested at random from each variety including standard varieties, irrespective of how big the field was. The following steps were followed in harvesting and collecting data from each of the trial sites.

- ✓ Harvested 5 x2m samples from each variety (total 10m) – randomly selected.
- ✓ The total number of plants within the 2 m counted – each variety.
- ✓ The total number of tubers (from 2m) counted – each variety.
- ✓ Tubers were grouped into 3 classes of 0-35mm, 35-50mm & above 50mm.
- ✓ Each category counted and weighed and summed.
- ✓ Overall yield per variety, in terms of the number of tubers and weight, (from the 10m) was recorded.
- ✓ Tuber skin texture, colour (skin & flesh), tuber shape recorded.

## 5.3 Data collection

Data collection took place throughout the growing stages for inspection of frost, diseases, and pests, up to harvesting (tubers counting, weighing, colour, and shape evaluation). Further, few selected tubers from each production zone were subjected to dry matter (moisture content) analysis.

### 5.3.2 Frost, Pests, and Diseases

The common pests attacking potatoes in Namibia are nematodes, potato tuber moth, aphids, and American leaf miners among others. Diseases that are generally complained about by Namibian potato growers include early bright, late bright, and common scabs (NAB, 2021). Proper monitoring and observation were employed and frost, pests, and diseases observed on the trials were recorded.

### 5.3.3 Harvesting Stage - Yield of Potato Varieties Harvested from Trials

Data in terms of the total number of tubers and their weight from each trial was recorded and analysed. The harvested tubers were separated into three groups to record the number and weight of tubers that are less than 35mm, between 35mm and 50mm, and larger than 50mm from each trial site and for each potato variety. Tubers greater than 50mm are regarded as marketable size. 5.3.4 Tuber Characteristics and other post-harvest data collected.

#### 5.3.4.1 Shape and Colour of Tubers

To get more phenotypical features of the varieties, the harvested tubers were also subjected to the tuber skin & flesh colour, and shape analysis. “Potato colours range from purple, red, pink, gold and yellow, in addition to the usual white” (Cornell University, 2006 as cited in NAB, 2021). Round, short, or long oval tuber shape is preferred for mashed and baked potatoes, whilst only long oval tubers are preferred for French fries (fresh chips), whereas round potatoes are good for retail shelves. Identification of colour and shape was subjective and the tubers were classified as per the table below.

**Table 2:** Attributes used for tuber characteristics identification

Attribute	Characteristic description
Skin and Flesh Colour	<ul style="list-style-type: none"> <li>- White</li> <li>- Whitish-Yellow</li> <li>- Yellow</li> </ul>
Tuber Shape	<ul style="list-style-type: none"> <li>- Long-Oval</li> <li>- Short-Oval</li> <li>- Oval</li> <li>- Round</li> </ul>

#### 5.3.4.2 Dry Matter Content

In the potatoes industry, dry matter content analysis is vital to ensure quality in the supply chain. “Potatoes have a water content that varies from 75 to 85% and the rest (15 to 25%) is a dry matter that contains the nutrients for which potatoes are grown” (Trimble, 2019 as cited in NAB, 2021). According to Lemanga and Kabira (2003) in NAB, 2021, potatoes with high dry matter content (above 20%) are mostly preferred for making French fries or crisps while those with low dry matter content are less preferred because the French fries or crisps will be too soft or too wet and it will need more heat to fry to evaporate the water. The dry matter content may also influence the colour of chips which plays a crucial role in customer satisfaction.

To determine the dry matter content of the potatoes harvested of each variety per production zone, tubers weighing at least 50g per variety were used. Potato tubers are homogenised by cutting the sample into smaller pieces and shortly blending. Fifty (50) gram sample is then weighed into a dish. Weight recorded dish and sample are dried in a 104°C oven for 4 hours. The sample is removed from the oven and allowed to cool in a desiccator. Weight recorded sample is placed back into the oven for 1 hour, cooled, and weighed, and this step is repeated until there is no significant weight change anymore.



## 5.4 Data Analysis

### 5.4.1 Descriptive Statistics

Descriptive statistics were used to analyse and present the results in tables and graphs. All the data collected as per the above section (Data Collection) were analysed using descriptive statistics whilst using the Microsoft Excel Software. Various tables and figures are listed throughout the report as well as their interpretation.

## 6. RESULTS AND DISCUSSIONS

This section (6) presents and discusses the parameters of the data collected and analysed to assess the performance of the potato varieties subjected to trials. The parameters include; frost, pests & diseases, yield, shapes, and colour (skin & flesh) of tubers, and dry matter content.

Unfortunately, Kavango and Zambezi production zones did not fully succeed in these trials, evidenced by yields that are too far below an average yield of 40 tons/ha in Namibia. The failure of these trials is due to poor farm management practices. NAB sponsored a mentorship service to the participant farmers, however, farmers did not fully adhere to the instructions of the mentor, hence the yields were severely affected. Kavango production zone had one trial site, whereas, the Zambezi had 6 trial sites and all these farmers were planting potatoes for the first time. This study will therefore make results analytics mostly based on the yields harvested from Karst and North Central production zones only.

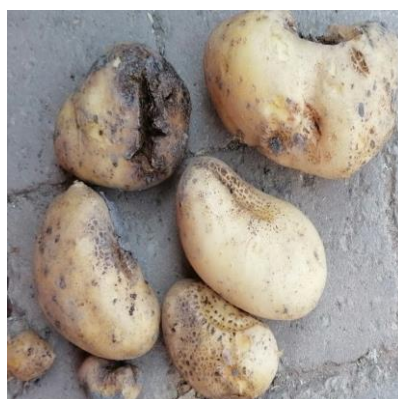
### 6.2. Frost, Pests, and Diseases.

No severe climatic factors were affecting the progress of the trials. However, one trial site in the Karst production zone was affected by frost, which killed most leaves of potato plants. However, plants were able to regenerate new leaves afterward, but the total potential weight of tubers above 50mm was affected approximately by 20%.

American leaf miner was the only pest identified on potatoes at one trial site in North Central. Early bright disease slightly affected one trial site in the Zambezi, with no observable selectivity among varieties. Some tuber deformities were observed on the outer side of a few tubers of Rainbow harvested from the Abenab trial site in the Karst production zone. Abenab trial site has more clay soil content than all other trial sites. Figures 2, 3 & 4 below presents some of the pests, deformities, and frost observed from the trials.



**Figure 2.** A sign of American leaf miner attack on the potato leaf.



**Figure 3:** Deformed tubers of rainbow observed at Abenab trial site only.



**Figure 4:** Potato field affected by frost (Guinas Trial Site only)- Farm Manager seen in Picture.

## 6.2 Gross Yields of Potato Varieties Harvested from Various Production Zones.

**Table 3:** Yield of potato trials from North Central, Kavango, Karst, and Zambezi horticultural production zones.

Parameter	Production Zone	Barcelona	Mondial	Montreal	Nicola	Rainbow	Satis	Spunta	Tyson
Number of Tubers between 0 and 35mm	North Central	123	159	139	242	159	171	130	52
	Kavango	132	100	47	48	127	183	111	
	Karst	88	178	209	283	185	180	134	120
	Zambezi	173	152	105	219	160	173	152	
Number of Tubers between 35mm and 50mm	North Central	75	68	71	87	67	88	79	51
	Kavango	22	19	47	52	29	11	59	
	Karst	99	126	118	152	147	139	106	75
	Zambezi	68	37	44	43	45	60	30	
Number of Tubers above 50mm	North Central	79	46	64	40	51	35	62	46
	Kavango	0	0	5	2	0	0	8	
	Karst	205	177	158	191	150	147	228	151
	Zambezi	17	12	9	8	21	8	19	
Total Number of Tubers	North Central	277	273	313	369	277	293	270	239
	Kavango	154	119	99	238	156	194	51	
	Karst	391	481	484	626	481	465	468	346
	Zambezi	258	201	159	270	226	240	202	
KG of Tubers between 0 and 35mm	North Central	3	4	3	6	4	5	4	4
	Kavango	2	1	3	3	0	2	2	
	Karst	3	6	6	6	4	4	3	3
	Zambezi	4	3	3	4	3	4	3	
Kg of Tubers between 35mm and 50mm	North Central	6	6	9	7	6	7	7	6
	Kavango	1	1	1	3	2	1	3	
	Karst	9	11	10	8	9	7	5	6
	Zambezi	5	2	3	3	3	3	3	
Kg of Tubers above 50mm	North Central	15	10	9	6	9	6	10	10
	Kavango	0.0	0.0	0.7	0.2	0.0	0.0	0.8	
	Karst	45	36	36	22	29	19	33	26
	Zambezi	2	1	1	1	3	1	2	
Total Weight (Kg) of Tubers	North Central	24	20	22	19	19	17	20	46
	Kavango	3	2	4	6	2	3	6	
	Karst	56	53	52	35	42	30	41	35
	Zambezi	11	7	7	12	10	8	8	
No of Plants from 10m (2m x 5)	North Central	27	34	32	30	34	26	35	36
	Kavango	35	33	35	34	35	34	35	
	Karst	44	42	45	43	47	45	41	45
	Zambezi	36	39	34	31	32	37	36	
Estimated Yield/Ha (Tonnes)	North Central	40	33	36	32	32	29	34	34
	Kavango	6	3	7	9	3	5	10	
	Karst	94	88	86	59	70	49	68	58
	Zambezi	18	11	10	10	17	13	13	
<b>Average for North Central and karst production zones only (Tons/ha)</b>		<b>67</b>	<b>60</b>	<b>61</b>	<b>45</b>	<b>51</b>	<b>39</b>	<b>51</b>	<b>46</b>
<b>Percentage Weight of tubers above 50mm: North Central and Karst production zones</b>		<b>74%</b>	<b>63%</b>	<b>61%</b>	51%	63%	52%	<b>70%</b>	45%

Table 3 above indicates the average gross yields obtained from trial sites at each production zone, namely; North Central, Kavango, Karst, and the Zambezi. The average yields are expressed in terms of the number of tubers between 0 and 35mm, number of tubers above 35mm but below 50mm, number of tubers greater than 50mm (the marketable size), and the total sum of tubers harvested from a 10m portion. The same average yield categories were also expressed in terms of weight (kg), whilst the average number of plants from 10m randomly sampled from 2m x 5 portions per variety from trial sites at each production zone was also presented. Ultimately, the average yields per hectare are presented in tons per potato variety harvested from each of the four production zones.

Nicola was the most prolific variety harvested from all four production zones, but it had too many small tubers, hence its weight of tubers above 50mm was outperformed by all varieties except Satis. Spunta had the highest number of tubers above

50mm at Karst (228), however, its weight of 33kg for tubers above 50mm was outperformed by Barcelona (45kg), Montreal (36kg), and Mondial (36kg) at Karst production zone.

Barcelona (French variety) recorded the highest average gross yield (67 tons/ha). The French variety, Montreal (61 tons/ha) was the second-highest in average gross yield per hectare, whilst Mondial (Check variety) was the third-highest average gross yield (60 tons/ha). Both Rainbow and Spunta yielded an average of 51 tons/ha, whilst Tyson (check variety) had an average gross yield of 46 tons/ha, followed by Nicola (French Variety) had 45 tons per hectare. Except for Satis which yielded 39 tons/ha, all varieties attained yields above 40 tons per hectare, which is the average potato yield per hectare in Namibia.

### 6.3 Shape and Colour of Tubers

**Table 4:** Mode skin colour, flesh colour, and tuber shape of potatoes harvested from various trial sites.

Potato Variety	Tuber Skin Colour	Flesh Colour	Tuber Shape
Barcelona	Yellow	Whitish-Yellow	Long-Oval
Montreal	Yellow	Whitish-Yellow	Short-Oval
Mondial	Whitish-Yellow	Whitish-Yellow	Short-Oval
Nicola	Yellow	Yellow	Long-Oval
Rainbow	Yellow	Yellow	Short-Oval
Satis	Yellow	Whitish-Yellow	Long-Oval
Spunta	Yellow	Whitish-Yellow	Long-Oval
Tyson	Whitish-Yellow	Whitish-Yellow	Round

Table 4 above presents the mode tuber skin colour, flesh colour (inside the tuber), and tuber shapes observed on each potato variety harvested from various trial sites. There were no significant differences in skin and flesh colour between potato varieties, they are either whitish-yellow which is the traditional colour in the Namibian local market, or yellow which is not too far distinguishable from whitish-yellow. Long-oval and short-oval were dominating tuber shapes. It was observed that the final shape of the potato also depends on how well the tuber grew. Shapes of stunted grown tubers are difficult to judge.



**Figure 5:** Skin & flesh colours and tuber shapes of potato varieties harvested from various trial sites

Figure 5 above presents the mode colours of skin and inside tuber flesh, and shape of potato varieties harvested from various trial sites. All French varieties had a yellow tuber skin, whereas, Rainbow and Nicola had yellow flesh inside tubers, and the rest of French varieties had whitish-yellow flesh. Barcelona, Satis, Spunta, and Nicola look more like long-oval, whereas, Rainbow and Montreal look more like short-oval. Check varieties, Mondial and Tyson have whitish-yellow skin and flesh, however, Mondial is short-oval while Tyson is roundish.

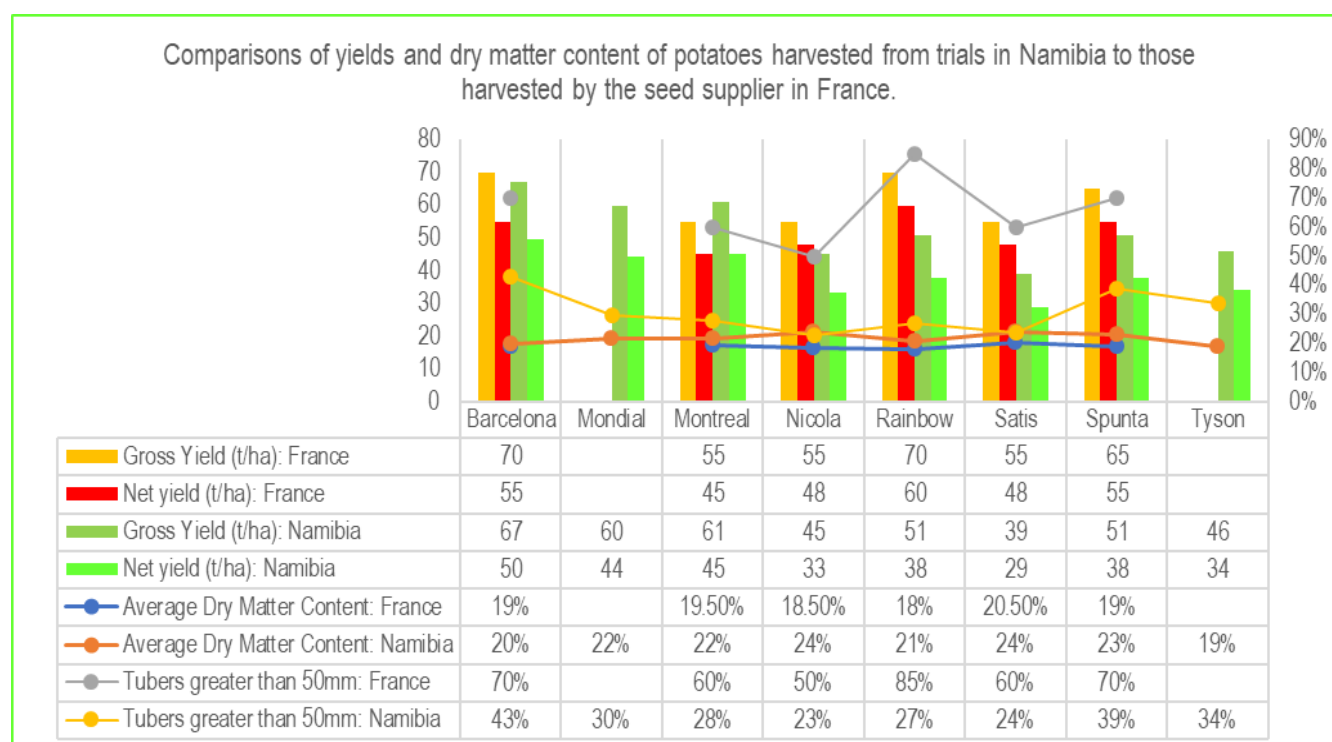
## 6.4 Dry Matter Content

**Table 5:** Test report on the dry matter contents of the potatoes harvested from trial sites at various production zones

Variety	North Central Production Zone: Tubers' Dry Matter %	Zambezi Production Zone: Tubers' Dry Matter %	Karst Production Zone: Tubers' Dry Matter %	Average Dry Matter %
Barcelona	20%	22%	18%	20%
Montreal	24%	20%	23%	22%
Mondial	24%	22%	21%	22%
Nicola	26%	24%	21%	24%
Rainbow	23%	22%	18%	21%
Satis	21%	27%	24%	24%
Spunta	24%	24%	20%	23%
Tyson	19%			19%

Table 5 above presents the test report of the dry matter content analysis done on the potatoes harvested from various trial sites at three different production zones, except Kavango. Though Nicola and Spunta remarkably scored highest (24% each), all varieties under trials are within the normal dry matter content for potato industries, which is 15% to 25%. Potatoes with a dry matter content of less than 19% might give challenges in the preparation of French fries.

## 6.5 Comparisons of Yields and Dry Matter Contents: Namibia Vs France



**Figure 6:** Yields and dry matter content of potatoes harvested from trials in Namibia relative to the same in France.

Figure 6 above presents the summarised and average yields and dry matter contents of potatoes obtained from trials conducted in Namibia as compared to those obtained by the seed supplier in France. Montreal is the only variety that obtained a gross average yield in Namibia (61 tons/ha) greater than the average gross yield obtained in France (55tons/ha), as well as the net yield equivalent to its net yield obtained in France. Net weight is the gross weight of tubers harvested minus the weight of tubers below 50mm. The rest of the varieties performed below their relative average gross yields in France but discrepancies are so minimal for Barcelona, Spunta, and Rainbow. In terms of net weights, Barcelona is 9%, Spunta is 30%, Rainbow is 36%, Nicola is 31% and Satis is 39% lower in Namibia as compared to net weights obtained in France.

Gross weights and Net weights for potatoes harvested from trials in Namibia could also be better than the actual gross and net weights obtained. This is because, one of the main trial sites in the Karst production zone was affected by frost, whereas, two of the trial sites in the North Central had issues of occasional irrigation water supply failure. Shortcomings of inadequate or late fertilizer applications to potato trials were noticed at some trial sites. This has resulted in a smaller number of tubers greater than 50mm as indicated in Figure 6. Barcelona, Spunta, Montreal, and Rainbow have more proportions of tubers greater than 50mm than all other French varieties harvested in Namibia, however, only Barcelona and Spunta have a greater portion of tubers above 50mm as compared to check varieties. In terms of dry matter content, all varieties harvested in Namibia have a dry matter content higher than all those harvested in France. Moreover, all varieties irrespective of the country are within the normal dry matter content for potato industries (15% to 25%).

## 7. CONCLUSIONS AND RECOMMENDATIONS

### 7.1 Conclusions

Despite that the seed potatoes arrived towards wintertime, whereas potato is a warm-season crop, the potato trials were successfully planted, with two production zones (Karst and North-Central) giving presentable yields. Results of this 2<sup>nd</sup> trial provide longitudinal evidence of French potato varieties' adaptability to the Namibian environment and soil conditions. All six French potato varieties, namely; Barcelona, Montreal, Nicola, Rainbow, Satis, and Spunta can adapt to the Namibian soil and climatic conditions, though at different intensities, primarily evidenced by successful growth & harvesting.

Barcelona resulted in the most average gross yield of 67 tons/ha, followed by Montreal (61 tons/ha) before Mondial, a check variety came third and has a yield of 60 tons/ha. Both Rainbow and Spunta yielded averages of 51 tons/ha, followed by Tyson (check variety) 46 ton/ha and thereafter, Nicola 45 ton/ha, and lastly, Satis 39 tons/ha. These yields are averages of Karst and North Central production zones only, whereas, Kavango and Zambezi production zones gave the yields too far below the national average yield of 40 tons/ha and it was due to unforeseen poor farming practices, which has little to do with variety characteristics. Data from Kavango and Zambezi are therefore not used in averages for this report as they may distort the results to assess varietal performance.

Yields obtained from trials conducted in Namibia, except the check varieties, were compared to yields obtained from similar varieties planted by the seed potato supplier in France. Montreal is the only variety that obtained a gross average yield in Namibia (61 tons/ha) greater than the average yield obtained in France (55tons/ha), as well as the net yield equivalent to its net yield obtained in France (45 tons/ha). The rest of the varieties performed below their average gross yields obtained in France, however, discrepancies are so minimal for Barcelona, Spunta, and Rainbow. In terms of net weight (total weight

minus weight of tubers less than 50mm), which is the marketable yield, French varieties yielded lesser net weight in Namibia relative to net weights obtained in France.

There were no significant differences in the attack by American leaf miners that was observed at one trial site in North Central. Some tubers of Rainbow manifested some cracks and deformed shapes at one trial site in the Karst production zone. Another trial site in the Karst production zone was affected by frost but regrown at later stages and managed to reach the harvesting stage. In terms of colours, French varieties are more of yellow skin, whilst check varieties are whitish-yellow but with negligible differences. Only Rainbow and Nicola have yellow flesh inside tubers, the rest of the French varieties have a whitish-yellow flesh, more so the check varieties.

The shapes of potato tubers harvested were as follow: long oval potatoes found to be; Spunta, Nicola, Satis, & Barcelona, short oval potatoes found to be; Mondial, Montreal, and Rainbow, whereas, Tyson found to be roundish. The shapes of potato tubers can be difficult to classify, especially when they didn't reach the normal size or whenever they overgrew into extra-large sizes. On another note, tubers harvested from trials were also subjected to the *dry matter content analysis*, whereby Nicola and Spunta scored highest (24% each), all varieties under trials are within the normal dry matter content for potato industries. Potato varieties harvested in Namibia showed higher dry matter contents relative to the same varieties harvested in France.

## 7.2 Recommendations

Considering the performance of potato varieties in terms of yields, the interior and exterior traits, it is worth recommending French potato varieties for adoption by Namibian Potato growers as previously recommended in the first trial report of French potato varieties' trials by NAB. Access to these French seed potato varieties should be realised to complement the existing local supply chain, that is wholly dependent on South Africa. The 1<sup>st</sup> trials singled out specific potato varieties such as Spunta, Rainbow, Barcelona as highly recommendable for adoption by Namibia as they did not only score high yields but also a significant number of uniformed tubers that are larger than 50mm as compared to other French varieties

Results of this 2<sup>nd</sup> trial endorse recommending Barcelona, Spunta, and Rainbow varieties as previously done in the 1<sup>st</sup> trials. However, Montreal is also recommended now as it also scored high yields than all other French varieties (except Barcelona) and check varieties. Spunta and Rainbow scored the yields close to Mondial (check variety). Though they scored yields below the check variety (Mondial), Spunta and Rainbow scored high average yields than Satis and Nicola, as well as Tyson (check variety).

Furthermore, as it was stated in the 1<sup>st</sup> trial report, producers who wish to commence procuring seeds from France can do so by obtaining an import permit from the Plant Health Division of The Ministry of Agriculture, Water and Land Reform, provided the seed supplier provides a phytosanitary certificate from the Government of France. The Seed and Seed Varieties Act No 23 of 2018 has been passed by Parliament, but it has not yet been brought into force, as the regulatory modalities are still being developed. Once this Act is brought into force, Section 11 of the Act states that "no person may import into Namibia any seed- unless the seed- is of a variety of which denomination is entered in the register, comply with any prescribed requirements, packed in a container which is sealed and branded, marked or labelled in the prescribed manner with the prescribed information and the seed variety should be imported through the prescribed port of entry".

As previously highlighted in the 1<sup>st</sup> trials' report, Section 34 of the Seed and Seed Varieties Act No 23 of 2018 states the compensation to farmers "where the seed of any kind or a variety of plant is sold to a farmer, the producer must disclose the expected performance of such kind of variety to the farmer under given conditions, and if, such registered seed fails to provide the expected performance under such given conditions, the farmer may claim compensation from the producers as if that seed had a hidden defect and the producer was an expert in the provision of seed". Another worth noting regulation is Bio-Safety Act No 7 of 2006 which expects importers or anyone handling GMO products to apply for a permit from the National Commission of Research Science and Technology (NCRST) in Namibia, which should contain a GMO risk assessment report and a GMO risk management plan. Approval of this permit application is at the discretion of NCRST though. In this case of GMO-free material, GMO-free certification or/and a written affidavit from the supplier of the seed materials is recommendable, which guarantees and safeguards the recipient of seed materials, in any case of unforeseen legal implications.

## 7. REFERENCES

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