IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)
e-ISSN: 2319-2380, p-ISSN: 2319-2372. Volume 8, Issue 1 Ver. II (Jan. 2015), PP 09-19
www.iosrjournals.org

Leaf Area IndexValues of Potato (*Solanum tuberosum* L.) Stored For Different Periods in Different Kinds of Stores

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Abstract: *A study was carried out at the National Root Crops Research Institute, Potato programme (NRCRI) Kuru, Jos Plateau State, Nigeria (Longitude 08^{O}E 47^{I}, Latitude 09^{O} N 44^{I} and altitude 1,239 metres above sea level (msl)during the 2012- 2013 to investigate the leaf area index values of Potato (Solanum tuberosum L.) Stored for different periods in different kinds of stores. Five potato varieties: Nicola, Bertita, Diamant, BR63-18 and Roslin Ruaka were stored for three periods: 12, 24 and 32 weeks in three types of stores, the Room temperature Store, Diffused light store (DLS) and Air conditioned store. During storage, the experimental design was completely randomized design in factorial combination of 5 potato varieties, 3 storage conditions and 3 storage durations. There were 45 treatment combinations replicated 3 times. During field evaluation, a split-split plot in Randomized complete block design was used with the potato varieties as the main plots, store type as the sub plots and storage duration as the sub- sub plots. A fourth replication was added for growth analysis study. Weekly temperatures and Relative humidity were recorded in each type of store. Leaf area index measurement was done weekly from six weeks after planting (WAP) using the disc method. The result showed that in all the varieties, storage durations and store types, LAI increased from 6WAP. Optimum LAI varied with variety with Roslin Ruaka having the highest (3.45) while BR62-18 had the lowest (2.16) with other varieties were in between. Leaf area index also varied with storage period with tubers stored for 32 weeks having the highest LAI, followed by storage for 12 weeks while storage for 24 weeks resulted in lowest LAI. Leaf area index also varied with store typewith seed tubers stored under Air condition having the highest followed by the Diffused light store while the Room temperature store had the lowest. Leaf area duration (LAD) varied with variety, storage period and store type. Roslin Ruaka had the highest LAD of 14.22 weeks while BR63-18 had the lowest LAD of 10.28 weeks while the other varieties were in between. Seed tuber storage under Air condition resulted in the highest LAD of 14.93 weeks followed by storage in Diffused light store with12.88 weeks while Room temperature storage had the lowest LAD of 11.13 weeks. The differences in leaf area index and leaf area duration between varieties, storage period and store type may be as a result of genotype, physiological age or environmental factors during subsequent crop growth in the field. Variety, storage period and store type with higher LAI values are expected to result in ahigher yield of crop compared to those with lower LAI values. LAI values gives information about crop growth and subsequent yield of the crop.*

Key Words*: Potato, Storage duration, store types, physiological age and leaf area index*

I. Introduction

Leaf Area index (LAI) has been defined as the area of green leaves per unit area of the ground and is considered a critical crop parameter (Jonckeeree*t al*., 2004). LAI is a dimensionless variable and was first defined as the total one-sided area of photosynthetic tissue per unit ground surface area (Watson, 1947). LAI is required to manage crop growth and to serve as a basis for plant growth analysis (Favarin *et al*., 2002; Dammer*et al*., 2008; Tavares Junior *et al*., 2002).

A high value of LAI has been suggested to indicate a denser or healthier crop canopy; while a low value represents sparse and or drier canopy (Boken and Chandra, 2012). LAI can therefore be used to assess crop condition or drought severity (Chaudhary, 1987). The LAI of vegetation has also been suggested to depend on species composition, developmental stage, prevailing site conditions, seasonality and the management practices (Jonckheeree*t al*., 2004). Welles (1990) reported that LAI is a dynamic parameter; it changes from day to day (mostly in spring and autumn) and driven by forest dynamics from year to year.

Jonckheeree*t al*. (2004) reported LAI in literature. They observed Published LAI values of forest to range from 0.40 for low-density seed tree stand of Querouspetraea (matus) Liebl (Le Dantec*et al*., 2000) to 16.9 for an old-growth (more than 200 years stand of Pseudotsugamenziesii (mirb.) Franco (Turner *et al*., 2000).Beadle (1993) reported that maxima between 6 and 8 are typically observed for deciduous forest and between 2 and 4 for annual crops. Schulze (1982) found that LAI for most biomes (apart from Desert and Tundra) ranged from about 3-19, the highest values being reported for boreal coniferons forest. Occasionally, Higher LAI values of up to 41.8 for evergreen broad-leaved stand have been published (Ni *et al*., 2001).

LAI in potato in general has been suggested to vary between 3.5 and 6.0 depending on the cultivar (Wright and Stark, 1990; Battilani and Mannini, 1993).Lopes *et al*. (2013) presented maximum values of approximately 4.3 at the 66 DAP. Bosco (2008) found that LAI reached a maximum value of 1.69 at the 45 DAP in cultivar Macaca. Nunes*et al*., (2006) obtained maximum value of LAI at 61 DAP in cultivar Monalisa. Potato plant leaf area at tuber initiation and thus the plant ability to intercept radiation during tuber bulking, strongly influences end of season tuber yield when nutrients and water are not limiting during bulking (Moorby&Milthurpe, 1975; Mackerron&Waister, 1985).

The propagation material used to grow potato is the seed tuber and the physiological age of the seed tuber is crucial for its quality as a planting material (Otroshy and Struik, 2008). The physiological age influences the productive capacity of the seed tuber (Ruest, 1986).Physiological age is defined as the physiological status of a seed tuber at any time, determined by genotype, chronological age and environmental conditions from time of tuber initiation until new plant emerges (Caldiz, 2009). Then the environment and management during crop growth, during the periods elapse between haulm killing-harvest, and harvest- storage, during storage, and finally during the preplanting and pre-emergence phases play key roles in determining the physiological age of a seed tuber and its impact on future crop growth, yield and quality (Caldiz *et al*., 2001).

The seed tuber can be physiologically too young (when taken from previous crop: short storage) or too old (when taken from last year'scrop: long storage at high temperatures) for planting (van Ittersum, 1992a, Struik and Wiersema, 1999). Crops from physiologically young seed tubers grow longer and are more yielding than those from physiologically old seed tubers. Wiersema (1985) found that crops from physiologically young seed tubers produce fewer stems, have later tuberization, more foliage and more tubers per stem than crops from physiologically old seed tubers.

Physiological age can be controlled by storage conditions. With higher temperature during storage, ageing goes faster than with lower temperatures (Struik and Wiersema, 1999). However, the way the temperature sum is built up during the storage season is also important, especially for cultivars with a high rate of natural ageing (Otroshy and Struik, 2008). Low storage temperatures (2-4^{o}C) is recommended when seed should be stored for longer than 6 months and used in long growing seasons in which physiologically young seed could better express its yielding potential (Caldiz, 2000). On the contrary when seed should be stored for shorter periods and used in short growing seasons, storage temperature could be higher in other to advance ageing (van Ittersum, 1992a).

A seed production system should consider the production of seed with suitable quality to fulfill future crop performance and consequent crop economy and the profits of a grower (Caldiz, 2009).

Potato growers in Jos Plateau, Nigeria store seed potatoes for different periods of time in any available space within the farmstead. This results in seed tubers of different physiological ages which in turn affect the yield of subsequent crop. The present study therefore aims to investigate the leaf area index values of potato stored for different periods in different kinds of stores. The LAI value gives information on the crop growth and is used to assess crop condition and eventually crop yield.

II. Materials And Methods

The study was carried out to investigate "Leaf area index values of potato (*Solanum tuberosum* L.)Stored for different periods in different kinds of stores" during the 2012-2013 season.

Experimental Site

The seed multiplication was carried out at the National Root Crops Research Institute, Potato programme (NRCRI) Kuru, Jos Plateau State, Nigeria. (Longitude 08^{O}E47^{I}, Latitude 09^{O} N44^{I} and altitude 1,239 metres above sea level.

Storage Conditions

Three types of stores were used: Room temperature store (Control), Diffused Light Store (DLS) and Air conditioned Store.

The Diffused Light Store (DLS)

A store structure based on the model developed by Nwokocha and Ifenkwe, (1991) was constructed in 2010 with little modification (while Nwokocha and Ifenkwe used mud blocks to keep the cost of construction as low as possible, compressed bricks were used to enable the use the store for other purposes after this research).

The structure consisted of double walls made of compressed bricks with inlet vents at the floor level and outlet vents on top of walls opposite the inlet vents. Plain and glazed glasses were fitted for illumination (Inside and outside walls respectively). The top was sealed off with mud decking and then overlaid with thatch. The space between the double walls was packed with acha (*Digitariaexilis*) straw to enhance insulation. The shutters for the doors and the vents were made of foam covered on both sides with 6mm plywood. The doors one on each wall opened in opposite directions.

The store made use of cool night air for cooling. The vents were covered with wire nets to prevent insects and rodents from getting into the store. The vents were opened in the night and closed in the early hours of the morning, that way; cool night air is trapped in the store and because of the insulation tends to remain cool all through the day (Nwokocha and Ifenkwe, 1991).

Air conditioned Store

This store consisted of a building made of compressed bricks and decked with mud. The windows were insulated with six inch foam. It was artificially lighted with low energy bulbs and the store was cooled with an air condition (1.5 horse power split unit air condition). Air condition was used because of the source of electricity-Nigerian electricity supply company (NESCO) is steady and reliable.

Room temperature store

The store received some light through the windows. This served as the control representing local farmers' potato storage practice.

The conditions in the storage includes: temperature, relative humidity, and light. Thermo-hydrometers (Humidity and temperature data loggers were installed in each store room and was used to measure the temperature and relative humidity in each store on 6 hour period. Mean minimum and maximum temperature for each day were measured using maximum and minimum thermometers.

Storage Durations (Periods)

Each store had tubers of each variety stored for the same period. The tubers were stored for 12, 24 and 32 weeks in each type of store and then taken to the field for planting. Each storage period resulted in seed of different physiological age. Seeds stored for 12 weeks were at the apical dominance sprouting stage, while those stored for 24 weeks were at the multiple sprouting stage, and seeds stored for 32 weeks were physiologically old depending on the conditions in the storage. Seed storage for 32 weeks was from rain fed harvest to rain fed planting (prolonged storage).

Experimental Design

In the store, a completely randomized design in factorial combination of 5 potato varieties, 3 storage conditions and 3 durations was used. There were 45 treatment combination replicated 3 times.

FIELD EVALUATION AFTER STORAGE

Afield was prepared: ploughed, harrowed and mapped out in line with the objective of the experimental design.

Experimental Design

A split-split plot in randomized complete block design was used with the potato varieties as the main plots, storage conditions as the sub plots and storage durations as the sub-sub plots. There were 45 treatment combinations, consisting of 5 potato varieties, 3 storage types and 3 storage durations replicated three times. A fourth replication was added and used for growth analysis study.

As each storage duration (period) was attained, (12 weeks, 24 weeks, 32 weeks), the tubers were removed from the store and taken to appropriate plots in the field. Those taken to the field during dry season (first and second storage durations) were irrigated 3 times a week by furrow irrigation before the rain was established.

The leaf area measurement was done by the disk method (Watson and Watson, 1953) using the modification by Bremnerand Taha, (1966) reported byIfenkwe (1975). This method involves the removal of leaves from the plant, determination of the total fresh weight and of the area/weight relationship of a sub-sample taken from the mass of leaves with a punch of known diameter. From this, the area of the whole leaf weight was estimated by simple proportion; the modification suggested by Bremner and Taha (1966) involved using a smaller punch than the one used by Watson and Watson (1953) in their experiment on sugar beet and taking only whole disks in calculating the area / weight relationship of the sub-sample. All fractional disks were discarded.

Bremner and Taha, (1966) found that this method was quite accurate despite Watson and Watson's (1953) objection that it introduced a bias towards the mid-rib of the leaf in the punched sample. The cross sectional area of the punch used in the work was $2.27cm^2$same as used by Bremner and Taha (1966).

Fifty disks were taken from each sample and placed in envelopes ready for drying. The rest of the leaves along with the remains of the punched leaves were weighed and put into numbered envelops. The stems (including auxiliary branches) were also placed in separate envelops and all plant parts were dried in an oven at 100^0C for 24 hours.

Leaf area duration is the sum total of weekly LAI over time, it was measured in weeks. From 6 WAP to 11WAP, the leaf area duration was calculated using the formula:

$$\Sigma \frac{L_2 - L_1}{\mathrm{Log_e} L_2 - \mathrm{Log_e} L_1}$$

Were L_1 and L_2 are leaf area indices for successive weeks.

III. Results

LEAF AREA INDEX (LAI)

Effect of Variety on LAI

In all the varieties, leaf area index (LAI) increased from 6 weeks after Planting (WAP). In Roslin Ruaka, Diamant, Nicola and BR 63-18, it continued to increase till 10 WAP after which it declined. The decline was much more in Diamant than the other three varieties (fig. 1).

BR 63-18 had the least LAI at all the sampling dates whereas Roslin Ruaka had the highest from 9WAP. Optimum LAI was obtained in all varieties at 10 WAP see figure 1. Roslin Ruaka resulted in highest optimum LAI of 3.45; this was followed by Diamant with optimum LAI of 3.15 while BR 63-18 had the least optimum LAI of 2.16(fig.1).

Effect of Storage Duration on LAI

With Nicola, LAI continued to increase till 11 WAP after seed storage for 32 weeks, while in seed storage for 12 and 24 weeks, LAI increased till 10 WAP and declined.Optimum LAI of 4.28 was reached at 11 WAP for tubers stored for 32 weeks while optimum LAI of 2.36 and 2.27 was reached at 10 WAP for tubers stored for 12 and 24 weeks respectively (fig.2).

With Bertita, LAI increased till 11 weeks for tubers stored for 12 weeks. For tubers stored for 24 and 32 weeks, LAI increased till 10 weeks and declined.Optimum LAI of 3.14 was reached at 11 WAP for tubers stored for 12 weeks. While optimum LAI of 2.27 and 3.40 was obtained at 10 WAP for tubers stored for 24 and 32 weeks respectively (fig.3).

With Diamant, LAI increased reaching an optimum of 4.75 after 32 weeks of storage. While tubers stored for 12 and 24 weeks reached optimum LAI of 2.35 and 2.73 at 9 and 10 WAP respectively and declined (fig.4).

With BR 63-18 tuber stored for 12 weeks, there was rapid increase in LAI after 10 WAP reaching optimum value of 3.2. For tubers stored for 24 weeks, LAI continued to increase reaching optimum of 2.40 at 10 WAP and declined while for tubers stored for 32 weeks, LAI continued to increase till 11 WAP (fig.5).

With Roslin Ruaka, 32 weeks of tuber storage resulted in extremely high LAI of 5.59 at 11 WAP, whereasat 12 and 24 weeks of tuber storage optimum LAI of 2.94 and 2.69 respectively were attained at 10 WAP and thereafter declined (fig.6).

Effect of Store Type on LAI

With Nicola, tubers stored at Room temperature, potato plants reached Optimum LAI of 2.94 at 10 WAP and declined sharply. Tubers stored in Diffused light store also reached optimum LAI of 2.98 and declined slightly.While for tubers stored in the Air conditioned store, LAI continued to increase till 11 weeks after planting (fig.7).

With Bertita tubers stored at Room temperature, LAI continued to increase till 11 weeks after planting. For tubers stored in Diffused Light store and Air conditioned stores, LAI continued to increase and reached an optimum of 2.94 and 3.32 respectively at 10 WAP and then declined (fig.8).

With Diamant tubers stored at Room temperature and Diffused Light store, LAI continued to increase and reached an optimum of 2.78 and 3.03 respectively at 10 WAP and then declined sharply. Tubers stored in Air conditioned store also reached an optimum LAI of 3.66 at 10 WAP but declined slightly (fig.9).

With BR 63-18 tubers stored at Room temperature, LAI increased and reached an optimum of 1.56 and then declined early from 8 WAP. LAI increased and reached an optimum of 2.27 at 10 WAP and declined with Diffused light store. LAI increased till 11 WAP with tubers stored in Air condition (fig.10).

With Roslin Ruaka and tuber storage at Room temperature, LAI continued to increase and reached an optimum of 2.63 at 9WAP and declined slowly. With tubers stored in DLS, LAI continued to increase and reached an optimum of 3.49 at 10 WAP and declined sharply. While with tubers stored in Air conditioned store, LAI continued to increase till 11 WAP.

LEAF AREA DURATION (LAD)

Effect of Variety on LAD

Roslin Ruaka had the highest leaf area duration (LAD) of 14.22 weeks followed by Bertita and Diamant with LAD of 13.77 and 13.26 weeks respectively, while BR 63-18 had the least (10.28 weeks). Nicola was intermediate with 12.39 weeks (Table 1).

Effect of Storage Duration on LAD

Storing of seed tubers for up to 32 weeks increased leaf area duration. Leaf area duration (LAD) increased from 12 weeks of storage to 32 weeks of storage. Tubers stored for 12 weeks had the lowest LAD of 11.44 weeks. This was followed by 24 weeks of storage with LAD of 11.47 weeks while storage for 32 weeks had the longest LAD of 13.07weeks (Table 2)

Effect of Store Type on Leaf Area Duration

Air condition storage had the highest Leaf area duration of 14.93 weeks, followed by the diffused light store with LAD of 12.88 weeks and Room temperature had the least LAD of 11.13 weeks (Table 3).

IV. Discussion

LEAF AREA INDEX

Effect of variety

The result showed that in all the varieties, LAI increased to an optimum after which it declined. Bosco (2008) found Macaca cultivar in field conditions to reach a maximum LAI value of 1.69 at 45 DAP and afterwards declined considerably due to natural senescence of the leaves . Lopes *et al.* (2013) found LAI to increase from 1.4 at 26DAP and reached an approximate maximum of 4.3 at 66DAP and then declined to 3.56 at 86DAP.

The result also showed that LAI varied with variety BR63-18 having the least optimum LAI of 2.16 while Roslin Ruaka had the highest optimum LAI of 3.45 with other varieties in between. The differences in LAI may be due to differences in number of leaves per plant. Beadle (1993) suggested maximum LAI of between 2 to 4 for annual crops. Battilani and Mannini (1993) described that the values of LAI in Potato in general vary between 3.5 and 6.0 depending on the cultivar.

Effect of Storage Duration

The result showed that tubers stored for 32weeks resulted in higher LAI values, followed by tubers stored for 12 weeks while tubers stored for 24weeks resulted in lowest LAI values. Seed tubers stored for 12weeks may be regarded as physiologically too young (depending on the variety) due to short storage period. Varieties like Nicola and Bertita were just breaking dormancy. While seed tubers stored for 32 weeks may be regarded as physiologically too old due to long storage at high temperatures. Physiological age being determined by chronological age and storage factors especially temperature while seed tubers stored for 24weeks was in between 12 to 32 weeks.

The vigour of the potato plant is affected by many factors: physiological age, genotype, environment (Nutrition, water supply, and climate) etc. for example Header and Beringer (1983) observed that culm growth can be stimulated by nutrient supply which favours' leaf growth and a rapid attainment of an optimal LAI. Also, depending on the genotype x environment interaction, the LAI of the culture can vary even for plants in the same plant phenology stage (Motta*et al*. 2000).

The effect of storage duration on LAI appears to be affected by both physiological age and environmental factors. Higher LAI values seen in tubers stored for 32 weeks may be as a result of environmental factors during growth of seeds in the field after the storage period. The crop was in the field between the months of May – August, 2013 thus it was rain fed (Sufficient water) and cool climate. The low LAI values after 24 weeks of seed storage may also be as a result of Environmental factors. The crop was in the field during the months of March to June and was irrigated (not as much water as in the rain fed crop) and extremely high day and night temperature. The crop can be said to have grown at a lower moisture and higher temperature. While tubers stored for 12 weeks was also irrigated but the crop was in the field during harmattan which was characterized by cool night temperature. Deguchi*et al.* (2010) found out that in irrigated field every cultivar could attain a LAI of more than 3, which is the lower limits for full radiation interception. While Haverkort*et al*. (1991) reported that in droughted field however, severe droughts drastically reduce LAI in all the cultivars resulting in lower yield.

Effect of Store Type

Tubers stored in Room temperature resulted in lowest LAI; this is followed by tuber storage in DLS while the Air conditioned store had the highest LAI. The factors that differ in the three types of storages are temperature, and relative humidity. Tubers stored at room temperature are at higher temperature followed by the diffused light store while temperature was lowest in the Air conditioned store. Storage temperatures determine the physiological age and tuber yield in cultivars sensible to ageing (Caldiz, 1991) with higher temperature s during storage, aging goes faster than with lower temperatures (Struik and Wiersema, 1999). Crops from physiologically young seed tubers grow longer and are more yielding than those from physiologically old seed tubers. Wiersema (1985) found that crops from physiologically young seed tubers produce fewer stems, have later tuberization, more foliage and more tubers per stem than crops from physiologically old seed tubers. Rykaczewska (2010) observed that generally, plants grown from the seed tubers subjected to high temperature during storage were shorter, had a lower weight of shoots and a lower LAI than plants grown from tubers stored under optimal conditions. The final yield of crops grown from seed tubers from high temperature during storage were significantly lower than the final yields of crops from seed tubers from optimal condition.

LEAF AREA DURATION

Effect of variety

The result showed that the varieties differ in leaf area duration (LAD). Roslin Ruaka had the highest (14.22 weeks) while BR63-18 had the lowest (10.28 weeks) with other varieties in between. This may have been influenced by the genetic composition, physiological age of the seed tubers or by environmental conditions during crop growth in the field. Jefferies and Mackerron (1993) examined canopy expansion, growth and yield of 19 genotypes of potato grown with irrigation or droughted and found that in the irrigated treatment, genotypes differed both in the maximum LAI achieved and in the duration it was maintained.

Effect of storage duration

The duration (period) of storage differed in leaf area duration (LAD).Tubers stored for 12 weeks resulted in the lowest LAD (11.44 weeks), followed by storage for 24 weeks with LAD of 11.47 weeks while storage for 32 weeks had the longest LAD of 16.31 weeks. This may have been influenced by physiological age of seed tubers and environmental conditions during crop growth in the field. The prolonged LAD after 32 weeks of seed storage may be because the crop was rain fed and the climate was cool. Drought has been reported to reduce rate of canopy expansion and maximum LAI achieved and by implication LAD (Jefferies and Mackerron, 1993, Haverkort*et al*. 1991).

Effect of store type

Leaf area duration (LAD) varied with type of storage. Seed tuber storage under Air condition resulted in the highest leaf area duration of 14.93 weeks, followed by storage under diffused light store with LAD of 12.88 weeks while storage at Room temperature resulted in the lowest leaf area duration of 11.13 weeks. Although the chronological age of the seed tubers in all the store types was the same, the different store types resulted in seed tubers of different physiological ages. Seed tubers from the air conditioned store were physiologically young due to the lower temperature while seed tubers from the Room temperature store were physiologically older due to a higher storage temperature. Physiological ageing has been reported to be controlled by storage conditions. With higher temperatures during storage, ageing goes faster than with lower temperatures (Struik and Wiersema, 1999). Physiological age has been reported to have great impact on future crop performance from emergence, stem number, tuber initiation, tuber number per stem, secondary growth, haulm growth, tuber yield and maturity (Struik, 2006, Caldiz, 2009). Crops from physiologically young seed tubers grow longer and are more yielding than those from physiologically old seed tubers (Otroshy and Struik, 2008).

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Effect of Variety OnLAI

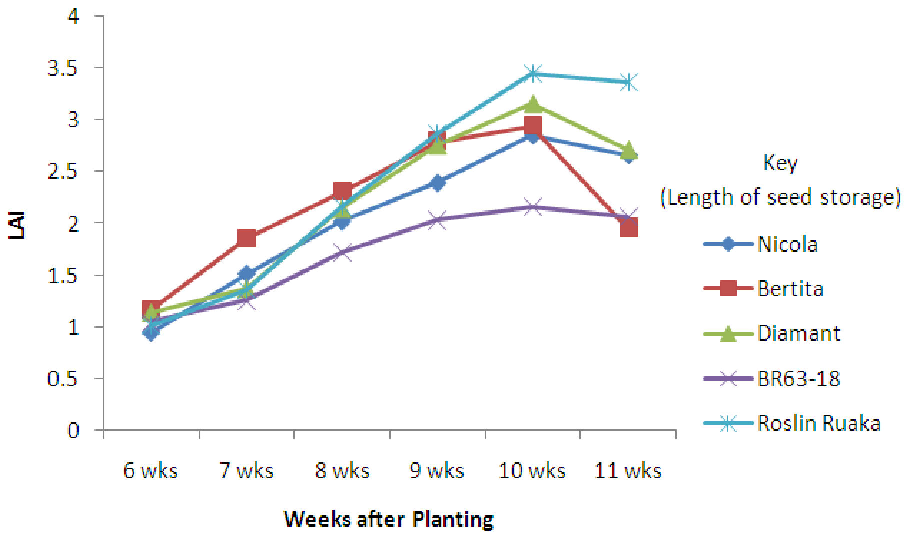

Figure 1: Effect of Variety on LAI

Effect of Storage Duration on LAI

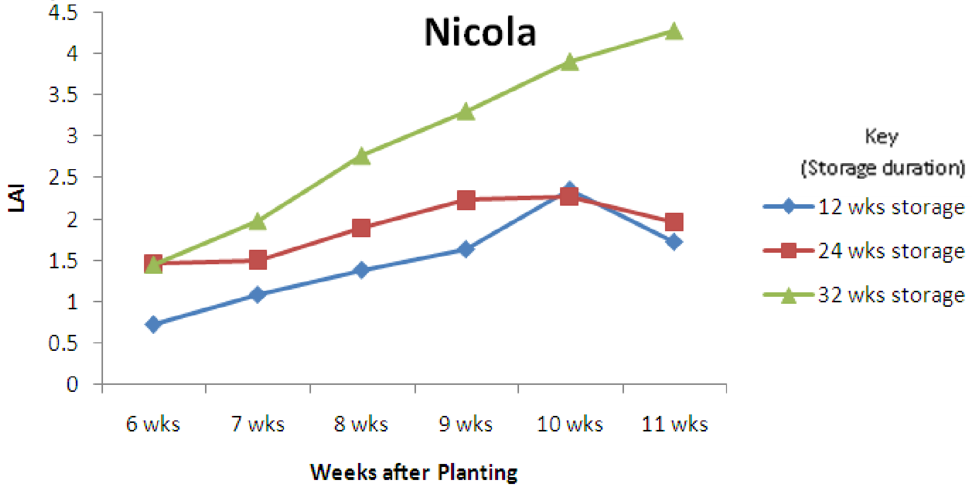

Figure 2: Effect of storage duration on LAI of variety Nicola

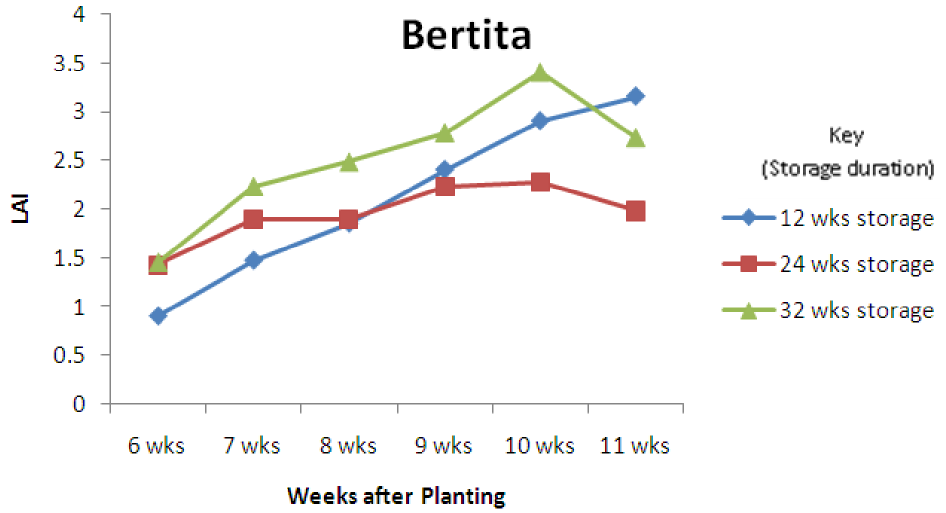

Figure 3: Effect of storage duration on LAI of Variety Bertita

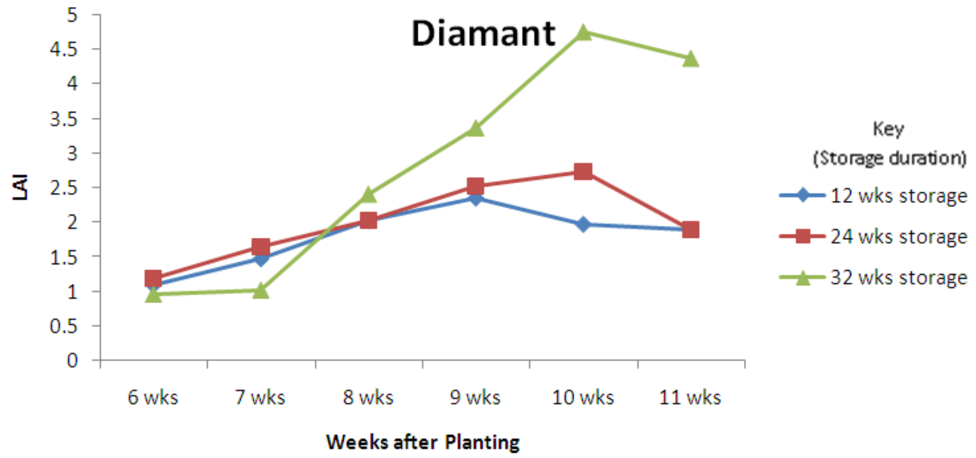

Figure 4: Effect of storage duration on LAI of Variety Diamant

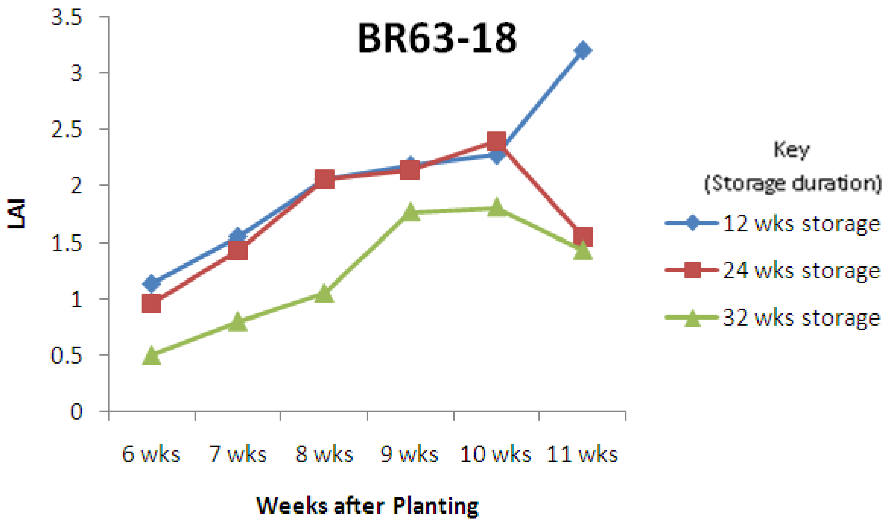

Figure 5: Effect of storage duration on LAI of Variety BR63-18

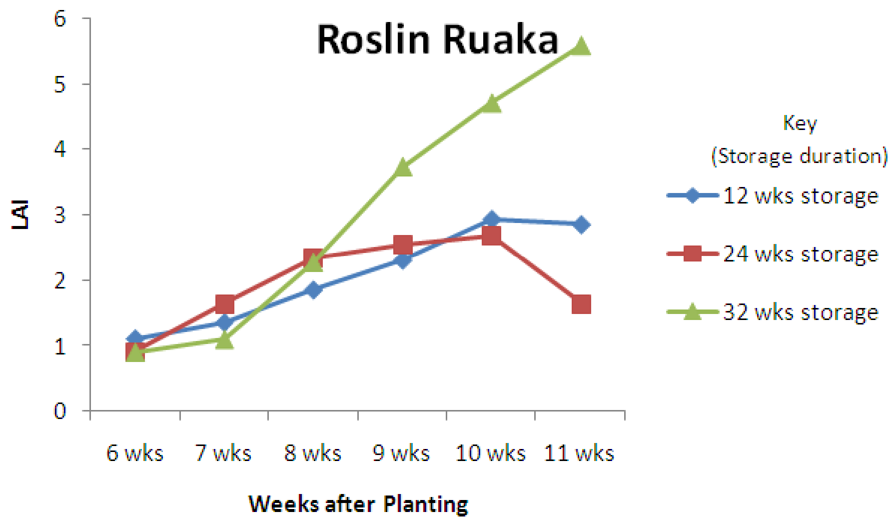

Figure 6: Effect of storage duration on LAI of Variety Roslin Ruaka

Effect Of Store Type On LAI

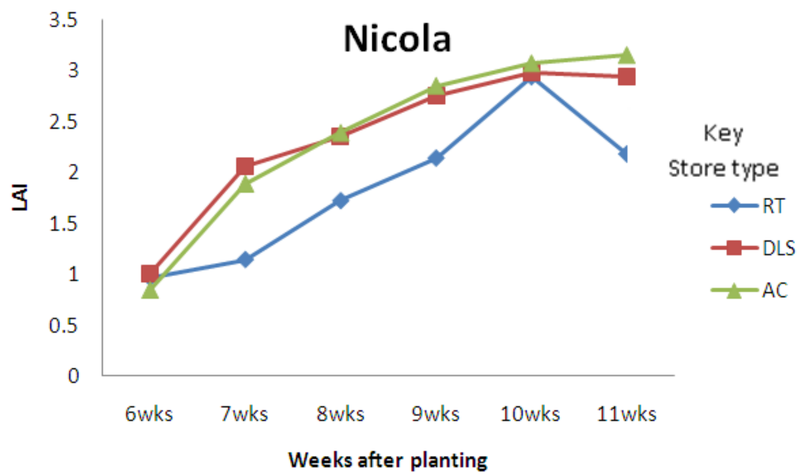

Figure 7: Effect of Store Type on LAI of Variety Nicola

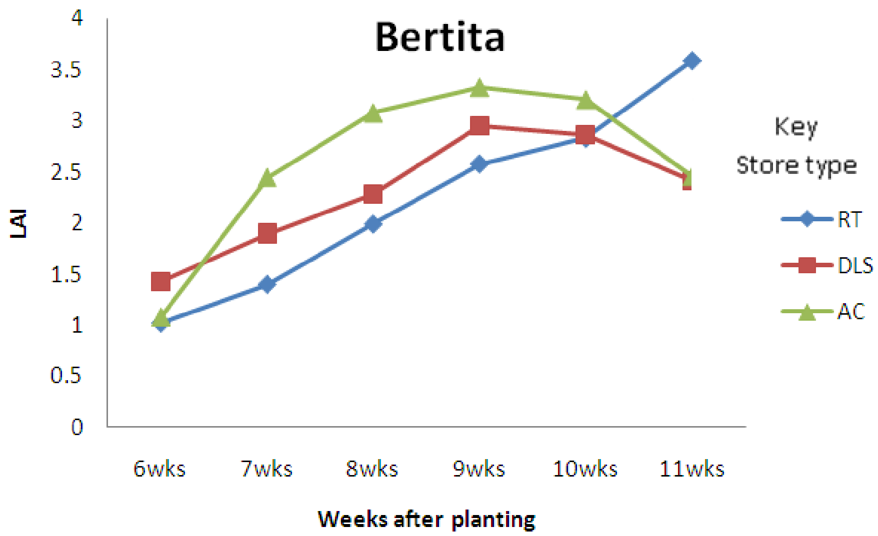

Figure 8: Effect of Store Type on LAI of Variety Bertita

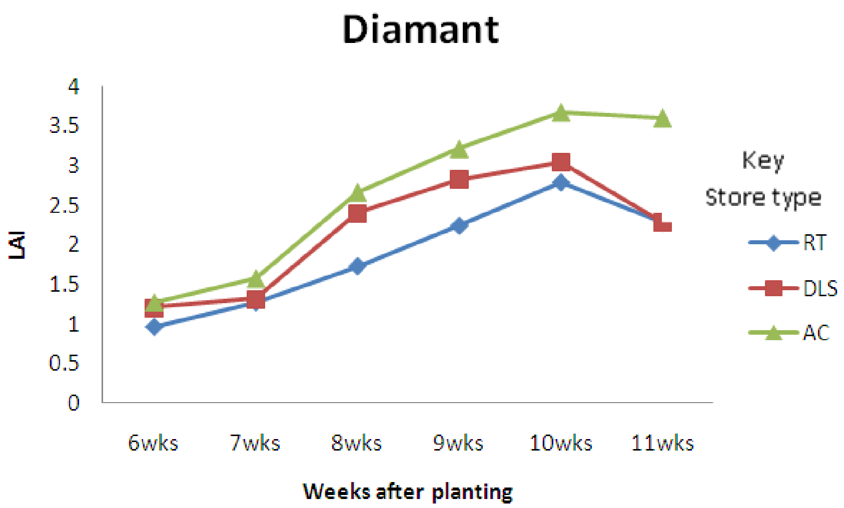

Figure 9: Effect of Store Type on LAI of Variety Diamant

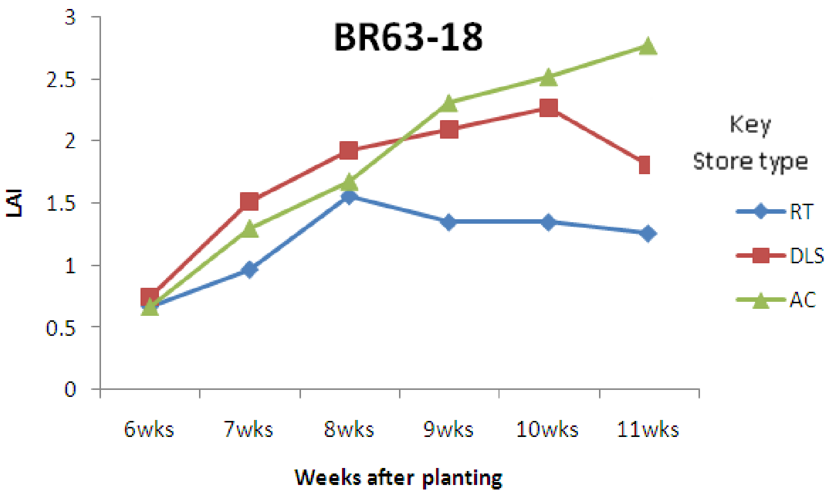

Figure 10: Effect of Store Type on LAI of Variety BR63-18

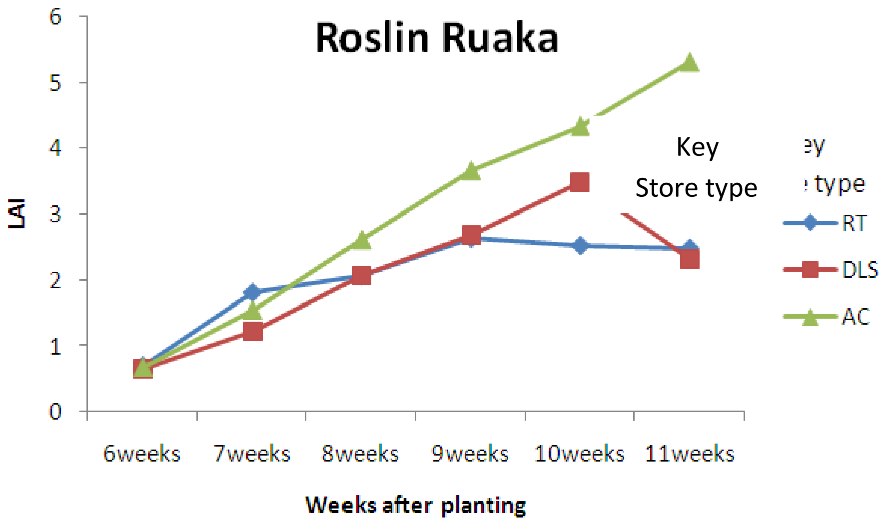

Figure 11: Effect of Store Type on LAI of Variety Roslin Ruaka

Table 1: Effect of variety on leaf area duration

Treatment	Leaf Area Duration (weeks)
Variety	
Nicola	12.39
Bertita	13.77
Diamant	13.26
BR 63-18	10.28
Roslin Ruaka	14.22

Table 2: Effect of storage duration on Leaf Area Duration (weeks)

Treatment	Storage Duration		
Variety	**12 weeks**	**24 weeks**	**32 weeks**
Nicola	8.94	11.34	12.18
Bertita	12.67	11.69	12.66
Diamant	10.77	11.98	12.88
BR 63.18	12.39	10.54	13.77
Roslin Ruaka	12.41	11.79	13.87
Mean	11.44	11.47	13.07

Table 3: Effect of Store types on leaf area duration

Treatment	Store types		
Variety	**Room temperature**	**Diffused light store**	**Air condition**
Nicola	11.09	14.10	13.13
Bertita	13.35	13.78	14.23
Diamant	11.21	13.01	13.38
BR 63.18	7.44	10.77	9.93
Roslin Ruaka	12.56	12.73	14.22
Mean	11.13	12.88	14.93