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CHEMICAL AND TECHNOLOGICAL STUDIES ON SOME SUGAR BEET VARITIES UNDER TOSHKI AREA CONDITIONS.

By

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5. SUMMARY

The present study was carried out at the farm of the Desert Agricultural Research Station, Toshki Aswan Governorate, Upper Egypt, during 2017/2018 and 2018/2019 seasons, to find out the optimum harvesting age of some sugar beet varieties (Oscar poly, Athospoly, Sarah, Ravel and Friancesca) under Toshki conditions, as well as study the effect of post-harvest treatments and storage periods on yield and quality characteristics of the tested five sugar beet varieties under Toshki conditions.

The obtained results could be summarized as follows:

Experiment I

Effect of harvesting age on some sugar beet varieties:

The experiment included twenty treatments represent the combination of five sugar beet varieties as well as four harvesting ages of sugar beet plants (165,180, 195 and 210 days).

A Randomized complete block with three replications arranged in split-plot design was used. Harvesting ages were arranged in the main plots, while sugar beet varieties were distributed randomly in the sub plot .

Experiment II

Effect of post-harvest treatments and storage periods on some sugar beet varieties:

The experiment included sixty treatments represent the combination of three post-harvest treatments, four storage periods and five sugar beet varieties.

A Randomized complete block design with three replications arranged in a split – split plot. The three post-harvest treatments were randomly distributed to the main plot, the four storage periods were assigned as sub-plot and the five sugar beet varieties were allocated as sub-sub-plots.

The results could be summarized as follows:

Experiment I

1.1. Effect of harvest ages on root weight and yield properties:

1.1.1. Root fresh weight/plant:

- harvested ages was significantly affected the fresh root weight/plant, harvesting sugar beet after 195 days gave the best fresh root weight in the both seasons.

- Fresh root weight/plant was insignificantly affected by the interaction between varieties and harvest ages.

1.1.2. Beet yield:

- Sugar beet was increased significantly when harvested age delayed from 165 to 210 days in the two study seasons.

- Sugar beet Arthospoly variety surpassed the other varieties in beet yield, while Francesca variety contained the lowest values in both seasons.

- The interaction between sugar beet varieties and harvesting ages was significant effect on beet yield of sugar beet (Ton/fad). Arthospoly variety recorded the maximum root yield when harvested at age of 210 days in the both seasons.

1.1.3. Sugar yield:

- Harvesting age of 195 days showed that the highest sugar yield**.** Thereafter**,** sugar yield decreased with delaying harvest from 195 to 210 days in both seasons.

- Significant differences among sugar beet varieties in sugar yield. Arthospoly variety recorded the maximum sugar yield (Ton/fad.), meanwhile the minimum produced by Freancesca variety in two seasons.

1.2. Effect of harvest ages on juice quality properties:

1.2.1. Total soluble solids (TSS %):

- Delaying harvest age of sugar beet from 165 to 210 days caused the increase in total soluble solids percentage in both seasons.

- The tested sugar beet varieties were significant difference in total soluble solids in second season only.

1.2.2. Sucrose percentage:

- The age of 195 days gave the highest sucrose percentage on dry weight. Sucrose% of sugar beet significantly decreased with delaying harvest after at 195 days age in the 1st and 2nd seasons.
- Sugar beet varieties had significant differences in sucrose%. Sugar beet variety Arthospoly surpassed the other varieties in sucrose%, while the lowest values of this trait were recorded by Oscar poly variety (on dry weight basis) in both seasons.
- The interaction between harvesting ages and sugar beet varieties had a significant effect on sucrose%. Ravel and Arthospoly varieties gave the highest increase values of sucrose% (on dry weight basis) when harvested at age of 195 days in both seasons.

1.2.3. Reducing sugars percentage:

- harvesting age at 195 days recorded the best results in reducing sugar%**.** Thereafter**,** reducing sugar% increased by delaying harvest in the both seasons; respectively.
- Tested varieties sugar beet had insignificant difference on reducing sugars.
- Reducing sugar percentage significantly affected by the interaction between harvesting ages and sugar beet varieties.

1.2.4. Sodium content:

- The harvesting age at 195 days recorded the lowest sodium content, thereafter delaying harvest after 195 days age caused the increase in sodium content in both season.
- Sugar beet varieties had a significant difference in sodium content. Sugar beet Arthospoly variety contained the lowest values, while, Oscarpoly variety recorded the highest values in 1st and 2nd seasons.
- The interaction between harvesting ages and the studied varieties was significantly affected on sodium content.

1.2.5. Potassium content:

- The harvesting age at 195 days from sowing gave the lowest potassium content, thereafter potassium content increased with delaying harvest after 195 days in both seasons.
- There were significant differences among the five sugar beet varieties in the potassium content in the first season only. Where the lowest potassium content values produced by Ravel and Francesca varieties while, the highest mean values recorded by Oscar poly variety in both seasons.
- Potassium content significantly affected by the interaction between harvesting ages and sugar beet varieties.

1.2.6. α- amino nitrogen content:

- The harvesting age at 195 days gave the lowest values of α- amino N content , thereafter α- amino N increased with delaying harvest after 195 days age both seasons, respectively.
- Significant difference in the α- amino N content among tested five sugar beet varieties. Ravel variety gave the lowest values, meanwhile the highest values produced by Sarah and Arthopoly varieties in 1st and 2nd seasons; respectively.

1.2.7. Purity percentage:

- Delaying harvest age of sugar beet to 195 days age caused the increase in purity %. While it was decreased with delaying harvest after 195 days in both seasons.
- Sugar beet varieties had significant differences in purity% at all harvesting ages. Ravel variety at age of 195 days recorded the best values of purity%، while, Oscar poly variety contained the lowest mean values at different harvest ages in both seasons.

1.2.8. Sugar recovery percentage:

- Sugar beet harvested at age 195 days recorded the maximum values of sugar recovery % on dry weight basis.

- Sugar beet varieties had a significant difference in sugar recovery percentage. Ravel and Arthospoly varieties scored the highest values, while Oscar poly variety contained the minimum values (on dry weight basis) at different harvesting ages in both seasons.

- Sugar recovery% was insignificant affected by the interaction between harvesting ages and sugar beet varieties in the two seasons.

1.2.9. Sugar loss in molasses percentage:

- The harvesting age at 195 days gave the lowest values of sucrose loss in molasses, thereafter, sucrose loss in molasses% of sugar beet increased when delaying harvest after age 195 days in both seasons.

- Sugar loss in molasses % was significantly different among tested sugar beet varieties in both seasons at different harvest age, the lowest values of sucrose loss in molasses was obtained from Ravel variety, meanwhile, the highest values of sucrose loss in molasses was obtained from Oscar poly variety in the both seasons.

1.2.10. Beet quality index percentage:–

- The harvesting age at 195 days recorded the highest beet quality index percentage thereafter, beet quality index percentage of sugar beet decreased with delaying harvest from 195 to 210 days in both seasons.

- Ravel variety surpassed the other varieties in quality index of beet, while Oscar poly variety contained the lowest mean values in the both seasons.

- Beet quality index percentage significantly affected by the interaction between harvesting ages and sugar beet varieties.

1.2.11. PH value:

- Delay harvest age of sugar beet from 165 to 195 days significantly increase in pH value**.** Thereafter , pH value decrease with delaying harvest after 195 days) in both seasons.

- The tested sugar beet varieties differed significantly in pH value in the first season only. Sarah variety gave the highest mean value of pH while, Oscar poly variety contained the lowest mean values in the 1st seasons only.

1.2.12. Fiber percentage:

- Fiber percentage increased with increasing sugar beet from 165 to 210 days in both seasons.
- The examined varieties were insignificant difference in fiber percentage.
- There were insignificant interaction between sugar beet varieties and harvest age.

1.2.13. Moisture percentage:

- Delaying harvest age of sugar beet from 165 to 210 days caused the decrease in moisture% of sugar beet in both seasons.
- Ravel and Arthospoly varieties were superior the other varieties in moisture percentage, while Sarah variety recorded the lowest values at different harvest ages in two seasons.
- Moisture percentage was significantly affected by interaction between harvesting ages and sugar beet varieties in first season only. Harvesting Arthospoly variety at age of 210 days gave the lowest decreased of moisture percentage in both seasons.

Experiment II

2.1. Effect of post-harvest treatments on weight loss and yield properties:

2.1.1. Weight losses percentage:

- The results showed that post-harvest treatments had a significant effect on root weight loss in both seasons, the treatment by covering with leaves gave the lowest weight loss% compared to the other treatments. Increasing the processing delay from harvest time up to 6 days caused a significant increase in the loss weight percentage.

- Sugar beet varieties significantly differed in weight loss % with the processing delay. Francesca variety gave the lowest values of weight loss % while, Sarah variety gave the highest one in two seasons.
- All possible interactions were significantly effected in weight loss percentage except between storage periods and varieties in the 1st season as well as the second order interaction in the two seasons.

2.1.2. Beet yield of sugar beet (Ton/fad):

-Post-harvest treatments had a significantly effect on beet yield of sugar beet (ton/fad.), roots cover with leaves achieved the maximum values, while the roots under open air conditions directly recorded the lowest root yield. Root yield significantly decreased when the processing delay days increased from zero up to 6 days of most treated samples in the two seasons.

- The tested sugar beet varieties significantly differed in root yield (Ton/fad.). Arthopoly variety surpassed the other varieties in root yield, while Sarah and Francesca varieties produced the lowest values in 1st and 2nd seasons, respectively.
- The best root yield was produced by Arthopoly variety when processed in the same harvest in two seasons.

2.1.3. Sugar yield of sugar beet (Ton/fad):

- Post-harvest treatments had a significantly effect on sugar yield (Ton/fad.), the use cover with leaves recorded the highest values of sugar yield whereas, the lowest values of sugar yield was recorded for roots kept under open air conditions directly. Sugar yield (Ton/fad.) significantly decreased during increase storage periods.
- Sugar beet varieties significantly differed in sugar yield during storage periods. Arthopoly variety surpassed the other varieties in sugar yield ,while, Sarah and Francesca varieties contained the lowest values of sugar yield (Ton/fad.) in 1st and 2nd seasons; respectively.

- A significant interaction was found that all the different interactions between the studied factors. Arthopoly variety achieved the highest values when processed in the same harvest time with all post-harvest treatments in both seasons.

2.2. Effect of post-harvest treatments on juice quality properties:

2.2.1. Total soluble solids (TSS %):

- Post-harvest treatments had a significant effect on total soluble solid percentage, the roots without treatment contained the highest value of TSS%. Total soluble solid percentage of most treated samples significantly increased during storage periods.

-Sugar beet varieties significantly differed in TSS % of most treated samples. Sarah and Francesca beet varieties had the highest values of total soluble solid percentage in the both seasons.

- Sarah and Ravel varieties gave the maximum total soluble solid percentage when processed immediately (in the same harvest time) in both seasons.

2.2.2. Sucrose percentage:

- Post-harvest treatments had a significantly effect on sucrose% in both seasons. The maximum value of sucrose % produced by roots treatment by covering with leaves while, the minimum value of sucrose % when roots kept without treatment. Data also, showed that sucrose% decreased when the processing delay days increased from zero up to 6 days in the two seasons.

- Sugar beet varieties significantly differed in sucrose%. Arthospoly variety gave the highest value, while the lowest values on dry weight basis were recorded by Sarah variety in two seasons.

- The highest values of sucrose% were obtained from Ravel and Arhospoly varieties after harvesting immediately in both seasons.

2.2.3. Reducing sugars percentage:

- Post-harvest treatments had insignificantly effect on reducing sugar% in the both seasons. Reducing sugar% increased insignificantly of at all studied

treatments for all samples during processing delay from zero up to 6 days. The treatment by cover with leaves recorded the best value of reducing sugars percentage (on dry weight basis) compared to the roots storage without treatment in both seasons.

- Tested sugar beet varieties significantly differed in reducing sugar of sugar beet during storage periods. The lowest values of reducing sugars% were recorded with Ravel and Arthospoly varieties in the 1st and 2nd seasons; respectively.

-Insignificant interaction was found between all the different interactions between the studied factors.

2.2.4. Sodium content:

- Sodium content% of treated samples increased significantly in both seasons. Under covering with leaves the roots recorded the minimum values of sodium content compared to the roots without treatment had contained the maximum values of sodium content in the two seasons.

- Also, the data indicated that the lowest values of sodium content scored by Arthospoly variety, whereas Oscar poly variety had the highest values at all samples during storage periods.

- The all different interactions between the studied factors were significant in both seasons, except post-harvest treatments with storage periods and post-harvest treatment and varieties as well as the second order interaction in 1st season. The minimum sodium content was obtained from Sarah variety when processed in the same harvest time in both seasons.

2.2.5. Potassium content:

- Post-harvest treatments had a significantly effect on potassium content. The roots treated cover with leaves recorded the lowest values of potassium content compared to other treatments in both seasons.

- The sugar beet varieties significantly differed in potassium content at the different storage periods. Francesca variety recorded the minimum values, while the maximum values produced by Oscar poly in both seasons.

- The all different interactions between studied factors were significant in both seasons except the interaction between post-harvest treatment and varieties in 1st season only. The best values of potassium content recorded for Ravel and Francesca varieties when processed in the same harvest time in 1st and 2nd seasons respectively.

2.2.6. α-amino nitrogen content:

- Post-harvest treatments had a significantly effect on α- amino nitrogen content in both seasons, Roots treated by covering with leaves gave the lowest values of α-amino nitrogen content compared to other treatments. α- amino nitrogen increased significantly of at all studied treatments for all samples during processing delay from zero up to 6 days.
- The sugar beet varieties significantly differed in α- amino nitrogen content. Sugar beet varieties Arthospoly and Ravel had lowest values of α-amino content in the 1st and 2nd seasons respectively.
- All possible interactions were significantly effected in α-amino nitrogen in both seasons. Ravel variety scored the lowest α-amino nitrogen content when processed immediately with all post- harvest treatment in both seasons.

2.2.7. Purity percentage:

- The post-harvest treatments had a significant effect on purity%. The highest purity% gave when sugar beet roots covering with leaves. Purity% was significantly decreased with the increase in the storage period in both seasons.
- Sugar beet varieties significantly differed in purity % at the different storage periods. Ravel variety surpassed the other varieties in purity%, while Oscar poly variety contained the lowest values in the both seasons.

- All possible interactions were significant effected in purity percentage expect, the interaction between storage periods and varieties. The maximum values of purity% were obtained from Ravel variety after harvesting immediately with all post-harvest treatments.

2.2.8. Sugar recovery percentage:

Sugar recovery % of treated samples decreased significantly increased with processing delay from zero up to 6 days in the both seasons. Roots treated by covering with leaves contained the highest values of sugar recovery % compared to other treatments.

- Sugar beet varieties significantly differed in sucrose recovery% of sugar beet during storage periods. Arthospoly variety surpassed the other varieties, while Sarah variety recorded the lowest one on dry weight basis in both seasons.
- All different interactions between the studied factors were significant effect on sugar recovery except the interaction between post-harvest treatments and varieties, Ravel and Arthospoly gave the highest values of sugar recovery% dry weight basis when processed immediately in both seasons.

2.2.9. Sugar loss in molasses percentage:

-Sugar loss in molasses % was significantly affected by the post-harvest treatments. The lowest values were recorded when roots treated by covering with leaves whereas, the roots kept without treatment recorded the maximum one. Sugar loss in molasses% was increased with processing delay days increased from zero time (harvest time) up to 6 days in the both seasons.

- Concerning the varieties significantly differed in sugar loss in molasses % during storage periods. Ravel variety recorded the lowest sugar loss in molasses%, meanwhile Oscar poly variety recorded the highest one in both seasons.
- All possible interactions were significant except, the second order interaction in the first seasons. Ravel variety gave the best value when processed immediately with all post-harvest treatments.

2.2.10. Beet quality index percentage:

- Beet quality percentage was significantly affected by the post-harvest treatments. The root treated by covering with leaves recorded the highest value of quality index% , meanwhile the roots without treatment recorded the lowest one in the two seasons. Beet quality index percentage of most treated samples

significantly decreased with processing delay increased from zero up to 6 days in the both seasons.

- Sugar beet varieties significantly differed in beet quality% index of sugar beet. Ravel variety scored the highest value of quality index, while the lowest values produced by Oscar poly variety in both seasons.

- All possible interactions were significantly effect, except the interactions between post- harvest treatments and sugar beet varieties in second season only. The best quality% was obtained from Ravel variety when processed immediately with all post- harvest treatment in both seasons.

2.2.11. PH value:

- PH value was insignificantly affected by the post-harvest treatments. Increasing storage periods led to significant decreased in PH values in both seasons.

-Five sugar beet varieties significantly differed in pH value. Ravel variety gave the highest value of pH whereas, the lowest value of pH scored by Oscar poly variety.

- PH value was significantly affected by the all different interactions between the studied factors expect, between post- harvest treatments and storage periods in both seasons. The highest values of pH were obtained from Sarah variety after harvesting immediately.

2.2.12. Fiber percentage:

- Fiber percentage was significantly affected by post-harvest treatments. Increasing of storage periods up to 6 days led to significant increases in fiber percentage in both seasons .The lowest values of fiber% were recorded when roots treated by covering with leaves in both seasons.

- Significant different among tested sugar beet varieties. Arthospoly variety recorded the lowest fiber%, meanwhile Sarah and Oscar poly varieties recorded the highest one.

- The all different interactions between the studied factors were significant affected in fiber% except the interaction between storage periods and varieties as well as second order interaction in 2nd season. The lowest values of fiber% (5.61 and 5.22%) were obtained from Arthospoly variety when processed after 6 days from harvest time in first and second seasons; respectively.

2.2.13. Moisture percentage:

- Data showed that post-harvest treatments had a significant effect on moisture content. The root treated by cover with leaves recorded the best values of moisture% of roots. Moisture percentage significantly decreased with increasing storage periods up to 6 days in both seasons.
- Five sugar beet varieties significantly differed in moisture% of sugar beet. Arthospoly variety had the best values of moisture percentage, while the lowest values were recorded by Sarah variety in the both seasons.
- Ravel and Arthopoly varieties contained the best moisture when processed in the same harvest time.