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MANUFACTURING AND PERFORMANCE EVALUATION OF A SIMPLE UNIT FOR ROSELLE PETAL SEPARATION

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ABSTRACT: A simple unit was manufactured for separating Roselle petal distinguished of high productivity, simple design and low damage. The performance of the manufactured unit was studied under three Roselle varieties dark Roselle, light Roselle and white Roselle, four cutting petal pipe diameters 17, 19, 20 and 22 mm and four different span time between harvesting and petal separation [first day corresponded to moisture contents of 81, 83 and 84%, second day (corresponded to moisture contents of 75, 78 and 83%), third day corresponded to moisture contents of 71, 74 and 80%) and fourth day (corresponded to moisture contents of 69, 71.5and 75%)] for dark, light and white Roselle, respectively. The machine performance was evaluated in terms of unit productivity, petal damage, separation efficiency, required power, specific energy and separating cost. The experimental results revealed that harvesting losses as well as separating costs were minimum while separating efficiency was maximum under the following conditions: adjust cutting petal pipe diameters at 19 mm for dark Roselle, 20 mm for light Roselle and 17 mm for white Roselle. Operate the manufactured unit at the first day at moisture contents of 81% for dark Roselle, 83% for light Roselle and 84% for white Roselle.

Key words: Separation, petal, harvesting, roselle, dark roselle, white roselle, light roselle.

INTRODUCTION

Roselle (*Hibiscus sabdariffa* L.) belongs to the family Malvaceae, locally called "karkadi", is an important annual crop grown successfully in tropical and sub-tropical climates. The Roselle calyx consists of a group of petal, which surround and protect the flower petals. Roselle is used in food, animal feed, nutraceuticals, cosmeceuticals and pharmaceuticals. The juice from the calyxes is claimed to be a health-enhancing drink due to its high content of vitamin C and other antioxidants.

In Egypt, Roselle is cultivated mainly in Upper Egypt (especially in Qena and Aswan Governorates) representing about 93.9% of the total cultivated area. In Qena, the cultivated area is about 1,150 ha (45.83%) which either newly reclaimed area (966 ha) or valley old soil (189 ha). About 1,353 out of 2,648 tons (51.1% of the total production) of dry yield of Roselle are produced by Qena Governorate **(Hassan *et al.*, 2014).**

Harvesting of Roselle is carried out generally by intensive hand labor, the corola being picked singly at the appropriate stage. The fruit may be harvested when fully grown but still tender, when they can be easily snapped off by hand. Later harvesting requires clippers. Consequently, agricultural researchers have to develop the agricultural machines and equipment in order to give high efficiency and production.

Kotb (1997) manufactured a simple unit to separate the Roselle petal. It is consists of rotor, the shelling drum beater and concave rods grate fixed to steel supporting frame. A concave rods grate was constructed of a number of round flexible rods. The space between the rods was limited to 6 mm. On the circulation of drum separation unit, two orifices were fixed allowing

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to pass the heart of fruit but obstructs the petal. Feeding of the sheller unit was done from the top tank under acceleration condition due to the gravity action. **Naturl and Kleinhaderner (2000)** reported that harvesting commences once the calyxes have reached an optimum size. This point is generally reached shortly before the seed capsules are ready to open.15-20 days after blossoming the fruit is separated with the calyx petals manually, either by hand, or with knife. After wards, the seed capsules need to be carefully removed from the calyx. Round, sharpened metals tubes can be used for this, to cut away the seed capsules at the base and remove them. **Badr *et al.* (2005)** studied the engineering factors which affects Karkadi fruits threshing. The optimum threshing parameters were thresher drum speed of 4.03 m/sec., clearance between the thresher drums of 6 mm and seed moisture content of 20% Wb to obtain the suitable seed damage of about 8.4%, losses of about 2.6%, cleaning efficiency of about 87.0%, threshing efficiency of about 92.5%, machine productivity of about 0.8 Mg/hr., and power consumed of about 2.2 KW. **Ismail *et al.* (2008)** used a decoder (a simple hand-held gadget) to separate Roselle calyxes from capsules. The capsule was separated from the flower by placing the decoder at the receptacle part of the flower and push upward. **Mohamed *et al.* (2012)** stated that, in Sudan, the fully developed fleshy calyx is peeled from the fruit by hand and dried naturally in shade. **Eliwa (2012)** manufactured a simple unit to separate the Roselle petal. After the labor raising the wood feeding disk with separating petal, the mechanism was used to release seedpods directly. The simple mechanism consists of movable up and dawn 18 bars having 12 mm diameter and 22 cm length. The bar move in hollow metal pipe with slider crank mechanism which used to drives the piston up and down. **Turner *et al.* (2017)** designed a machine for removing the calyxes from the seed of a Sorrel bud includes a smooth surfaced return drum rotatably mounted to a frame and a cutting drum rotatable about a cutting drum axle and mounted to the frame in a tandem relationship with the return drum. The cutting drum has aplurality of circumferential blades oriented perpendicular to the cutting drum axle and are substantially equally space done from another. The cutting drum in combination with the return drum defines a throat there between for receiving sorrel buds. A drive simultaneously rotates the return drum and the cutting drum to cut calyxes from the seed of the sorrel bud.

The objectives of the present work are to

- Manufacture of a simple unit to be used for Roselle petal separation.
- Choose the most suitable operating conditions for petal separation of three most common types of Roselle.
- Evaluate the performance of the manufactured unit technically and economically.

MATERIALS AND METHODS

The main experiments were carried out during the year of 2016 at El-kasassin horticulture Research Station, Ismailia Governorate, Egypt to manufacture and evaluate the performance of a simple unit for Roselle petal separation.

Materials

Crop

Three varieties of fresh Roselle (high moisture content) were used to be separated by the manufactured unit. The used three varieties were dark Roselle, light Roselle and white Roselle.

The manufactured Roselle petal separation unit

The Roselle separation unit was manufactured and developed depending on the idea created by **Eliwa (2012)**. The Roselle separation unit consists of the following main parts as shown in Figs. 1 and 2.

Steel frame

A steel frame was made from steel angles of 5 mm thickness and 4×4 cm cross sectional area with overall dimensions of 60 cm length, 60 cm width and 60 cm height.

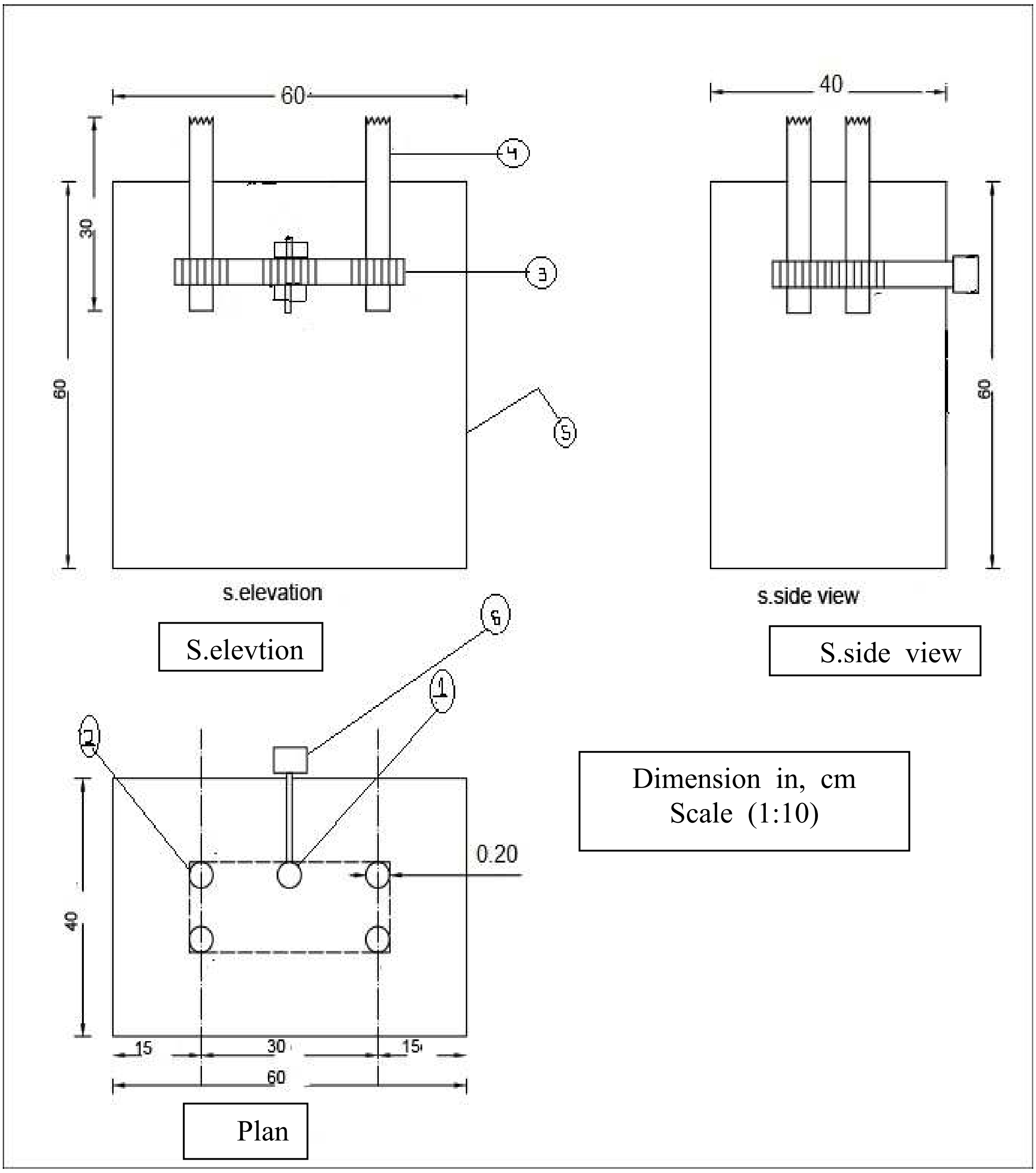
Electrical motor

Electrical two-phase motor of 1.0 hp

(0.75 kW) operated at 1440 rpm was used as a power source to operate the manufactured unit.

Separation unit

Separation unit consists of four hollow metal pipes with serrated sharp edge. The separation of Roselle petal was taking place as the labor press the fruits on the turning pipes.



No.	Part name	No. of parts	No.	Part name	No. of parts
1	Driver gear	1	4	Separating pipe	4
2	First gear	2	5	The frame	1
3	Second gear	2	6	Electrical motor	1

Fig. 1. Elevation, side view and plan of the Roselle petal separation unit

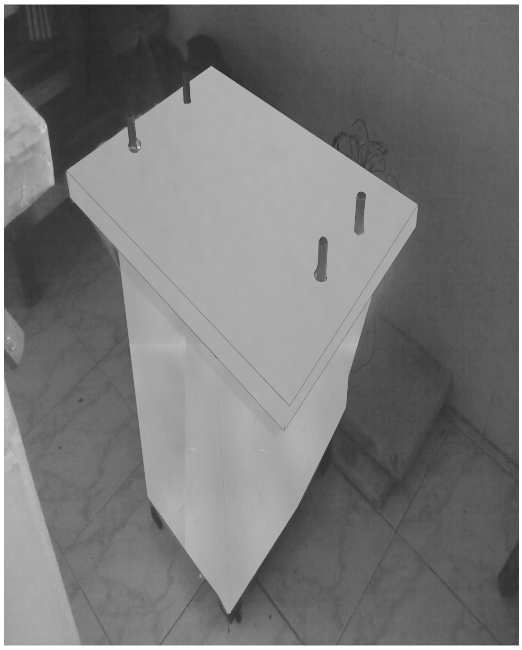


Fig. 2. The manufactured Roselle petal separation unit

Transmission system

Transmission system of one chain 125 cm was used to transfer the motion from electric motor to 4 gears after speed reduction of (16:1).

Methods

Experiments were carried out to evaluate the performance of the manufactured Roselle petal separation unit.

Separation petal steps

- The labor carries two fruits in his two hands and put them on two turning pipes. Another labor carries two fruits and put them on the other two pipes.
- The fruits were turned against clock wise direction to separate the petal from seed pods.
- The seedpods were removed from the pipe by hand.

Experimental conditions

The performance of the manufactured unit was evaluated under the following parameters:

- Three Roselle varieties (dark Roselle, white Roselle and light Roselle)
- Four cutting petal pipe diameters (17, 19, 20 and 22 mm).
- Four different span times between harvesting and petal separation [first day corresponded to moisture contents of 81, 83 and 84 %, second day (corresponded to moisture contents of 75, 78 and 83%), third day corresponded to moisture contents of 71, 74 and 80 %) and fourth day (corresponded to moisture contents of 69, 71.5and 75%] for dark, light and white Roselle,, respectively.

Measurements and calculations

The performance of the manufactured unit was evaluated taking into consideration the following indicators:

Moisture content determination

The moisture content of calyxes was obtained by adopting the procedure used for medicine and herbal plants **(Park *et al.,* 2002)**. This involved weighing samples, dried in a Gallenkamp oven at a temperature of 105^{o}C for 24 hr., cooled and weighed again to determine the amount of water in the calyxes. Moisture content (wet basis) was calculated as the ratio of the weight of water in the calyxes to the total weight of the calyxes before drying.

Determination of physical properties

Calyxes dimension

Thirty corola were used to determine physical dimensions of the corola. Length and width were obtained by measuring the length (L) (from base to the mid apex of the corola) and width (W) (measured around the base of whole corola fully opened up) with a digital venires caliper. Corola thickness (T) was measured using a micrometer screw gauge.

Sphericity and geometric mean diameter

Sphericity and geometric mean diameter (D_g) were calculated from the length, width and thickness obtained using the following equation according to **Mohsenin (1978):**

$$\text{Sphericity} = \frac{(L \times W \times T)^{\frac{1}{3}}}{L}$$

$$D_g = (L \times W \times T)^{\frac{1}{3}}$$

The surface area

The surface area was measured by tracing the corola on graph paper and calculating the area of squares covered by the corola.

Calyxes mass

A sample mass (about 30 g) of corola was selected and separated into complete, whole corola (*i.e.* those with 5 complete petal) and incomplete calyxes. The mass of the two separated fractions (*i.e.* mass of complete and incomplete corola) was obtained using an electronic balance and the percent of whole corola was obtained as ratio of mass of complete, whole corola to total corola (30 g) multiplied by 100. This procedure was repeated five times.

The unit mass of a single corola was also measured using the electronic balance. 30 g of corola were sorted. The mass of impurities (dry leaves, stones, stalks *etc*.) was determined and expressed as a percentage. This procedure was also replicated five times.

True and bulk density of corola

An empty container of known volume was loosely filled from a height of 1500 mm with the corola. The mass of the container and its contents were then determined using an electronic balance. The bulk density was calculated as ratio of mass of corola to volume of the container. This procedure was repeated five times. True density was obtained by liquid displacement method using toluene as liquid.

The manufactured unit productivity

The productivity of the manufactured unit was measured as the mass of separation petal (Wp) collected per hour. The productivity was calculated as follow:

$$\text{Unit productivity (kg/hr.)} = \frac{W_p}{T} \times 3.6$$

Where:

T - consumed time, sec.

Petal damage

The percentage of damaged petal (M_d) during fixing Roselle fruits in its orifices was calculated as follow:

$$\text{Petals damage (\%)} = \frac{M_d}{M_t} \times 100$$

Where:

M_t - the total mass of petal contained in fruits petal, g

Separation efficiency

The separation efficiency was calculated as follow:

$$\text{Separation efficiency(\%)} = \frac{M_c}{M_t} \times 100$$

Where:

M_c- mass of collected properly coherent petal, g

Required power and specific energy

The required power was calculated using the following equation **(Chancellor, 1981):**

Required Power (kW) = I V η Cos θ /1000

Where:

I - line current strength in Amperes.

V - the voltage, 220 Volt.

η - mechanical efficiency,

Cos θ - Power factor, 0.85.

Specific energy was calculated as follows:

$$\text{Specific energy(kW.hr./Mg)} = \frac{\text{Required power (kW)}}{\text{Unit productivity (Mg/hr.)}}$$

Separating cost

The separating unit hourly cost is estimated according to the conventional method of estimating both fixed and variable costs. While separating cost was calculated using the following formula:

$$\text{Separating cost (LE/Mg)} = \frac{\text{Unit hourly cost (LE/hr.)}}{\text{Unit productivity (Mg/hr.)}}$$

RESULTS AND DISCUSSION

The discussion will cover the obtained results under the following heads:

Physical Properties of Roselle Fruit

The characteristics of Roselle such as dimensions, mass, volume, density sphericity and porosity were measured to be considered during manufacturing of the separating unit.

The main dimensions of dark Roselle were 2.40, 2.37, 0.50 and 0.38 cm for length, width, thickness and neck diameter. While they were 2.82, 2.78, 0.4 and 0.54 cm for light Roselle. In addition, they were 1.65, 1.62, 0.2 and 0.36 cm for white Roselle under the same conditions.

Both sphericity and mass of 100 corola were 59% and 810 g for dark Roselle, 58% and 656 g for light Roselle and 49% and 1500 g for white Roselle.

Both true density and bulk density were 0.75 and 0.36 g/cm^3 for dark Roselle, 0.74 and 0.36 g/cm^3 for light Roselle and 6.4 and 5.2 g/cm^3 for white Roselle.

Both petal percentage and seedpods percentage were 40 and 60% for dark Roselle, 48 and 52% for light Roselle as well as 90 and 10% for white Roselle.

Effect of pipe Diameter and Span Time on Separating Unit Productivity

Concerning the effect of separating pipe diameter on separating unit productivity, results in Fig. 3 show that increasing separating pipe diameter from 17 to 22 mm, decreased unit productivity from 48.0 to 32.4, from 45.6 to 29.4, from 42.0 to 25.2 and from 36.0 to 21.6 kg/hr., under moisture contents of 81, 75, 71 and 69% for dark Roselle. While increasing separating pipe diameter from 17 to 19 mm, increased unit productivity from 44.0 to 46.8, from 41.9 to 45.6, from 38.4 to 45.0 and from 32.4 to 44.8 kg/hr. Any further increase in pipe diameter more than 19 up to 22 mm, decreased unit productivity from 46.8 to 36.0, from 45.6 to 40.0, from 45.0 to 27.6 and from 44.8 to 22.8 kg/hr., under moisture contents of 83, 78, 74 and 71.5% for light Roselle. On the other hand, increasing separating pipe diameter from 17 to 22 mm, leads to decrease unit productivity from 66.0 to 16.0, from 63.2 to 12.0, from 62.4 to 9.0 and from 61.2 to 7.0 kg/hr., under moisture contents of 84, 83, 80 and 75% for white Roselle. It is noticed that the decrease in unit productivity by increasing separating pipe diameter is attributed to that at high values of pipe diameter, the force for petal separating decreased resulted in low unit productivity. Relating to the effect of span time on separating unit productivity, results in Fig. 3 show that increasing span time from 1 to 4 days under pipe diameter of 17 mm, decreased unit productivity from 32.4 to 21.6 kg/hr., for dark Roselle, from 44.0 to 32.4 kg/hr., for light Roselle and from 66.0 to 61.2 kg/hr., for white Roselle.

Effect of pipe Diameter and Span Time on Petal Damage

Considering the effect of pipe diameter on separating unit productivity, Results in Fig. 4 show that increasing separating pipe diameter from 17 to 19 mm, decreased petal damage from 3.0 to 1.5, from 2.0 to 0.75, from 2.5 to 1.0 and from 3.0 to 2.0%. Any further increase in pipe diameter more than 19 up to 22 mm, increased petal damage from 1.5 to 5.0, from 0.75 to 4.0, from 1.0 to 7.0 and from 2.0 to 10%, under moisture contents of 81%, 75%, 71% and 69% for dark Roselle. On the other hand, increasing separating pipe diameter from 17 to 20 mm, leads to decrease petal damage from 4.0 to 1.5, from 3.0 to 0.5, from 3.5 to 1.0 and from 4.0 to 2.0%. While increasing separating pipe diameter more than 20 up to 22 mm, increased petal damage from 1.5 to 4.5, from 0.5 to 3.0, from 1.0 to 4.0 and from 2.0 to 5.0%, under moisture contents

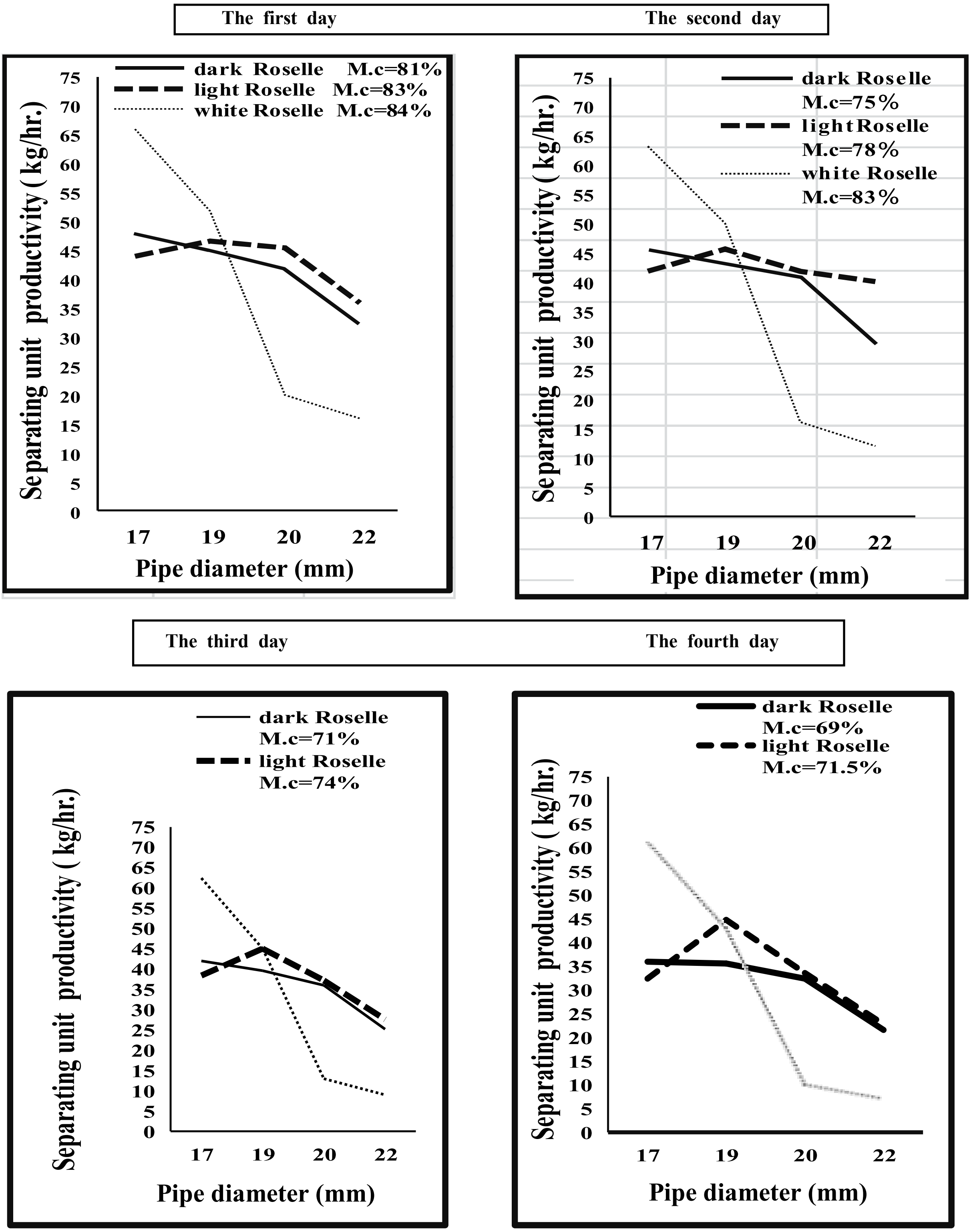


Fig. 3. Effect of pipe diameter and span time on separating unit productivity

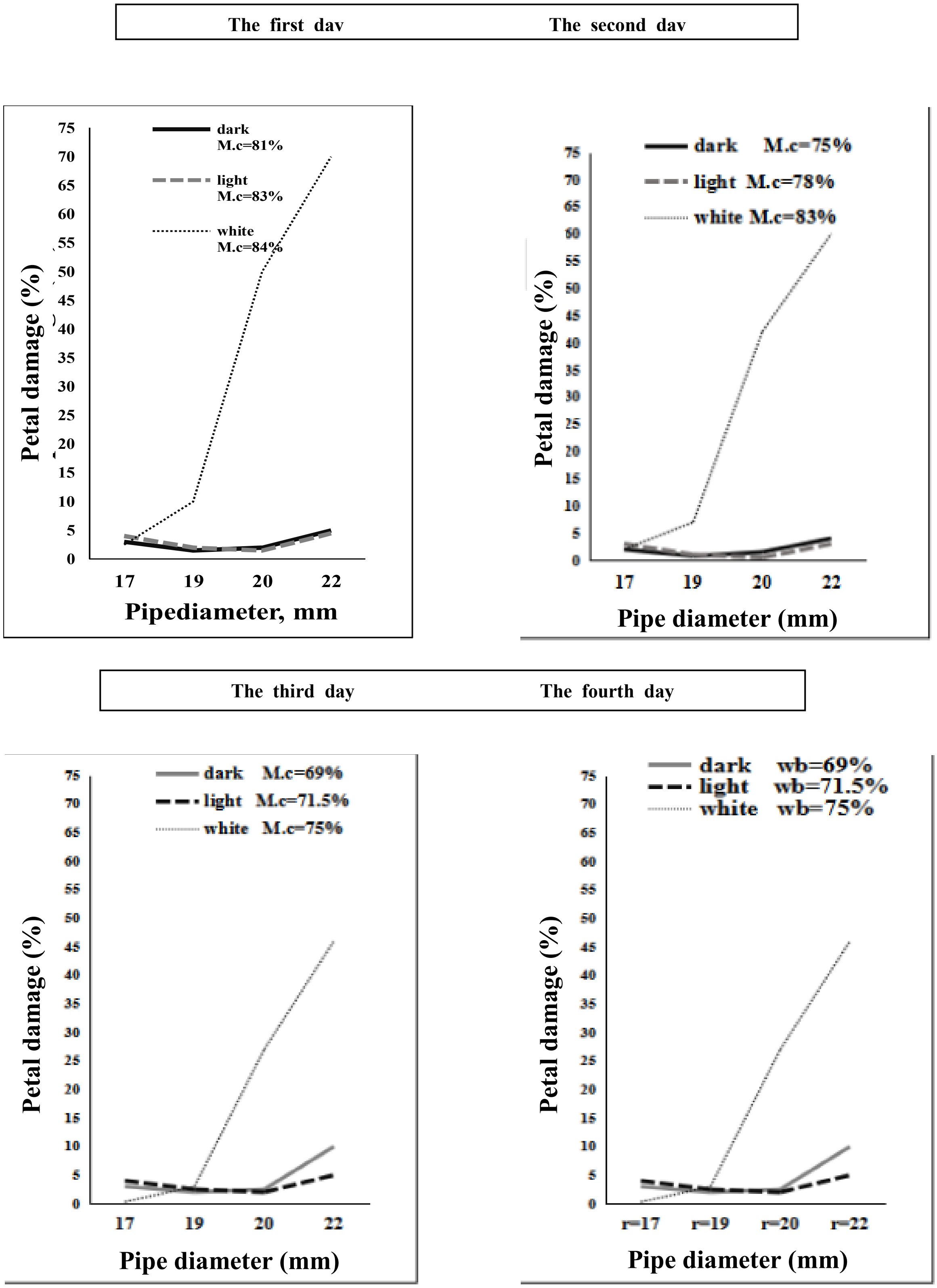


Fig. 4. Effect of pipe diameter and span time on petal damage

of 83%, 78%, 74% and 71.5% for the light Roselle. While increasing separating pipe diameter from 17 to 22 mm, increased petal damage from 2.5 to 70, from 2 to 60, from 0.5 to 50 and from 0.3 to 46%, under moisture contents of 84, 83, 80 and 75% for white Roselle. It is noticed that increasing separating pipe diameter more than petal diameter resulted in high petal damage. Also decreasing separating pipe diameter smaller than petal diameter resulted in high petal damage, as the separating pipe penetrates the seedpods and damage it which caused rots. It is also noticed that whenever the separating pipe diameter was closer to petal diameter resulted in low petal damage. So, the proper pipe diameter for decreasing petal damage is 19, 20 and 17 mm for dark, light and white Roselle, respectively.

Relating to the effect of span time on petal damage, results in Fig. 4 show that under pipe diameter of 17 mm, increasing span time from 1 to 2 days, decreased petal damage from 3.0 to 2.0%. However, increasing span time from 2 to 4 days, petal damage increased from 2.0 to 3.0% for dark Roselle. While increasing span time from 1 to 2 days, decreased petal damage from 4.0 to 3.0%. However, increasing span time from 2 to 4 days, petal damage increased from 3.0 to 4.0% for light Roselle.

Effect of pipe Diameter and Span Time on Separation Efficiency

Relating to the effect of pipe diameter on separation efficiency, results in Fig. 5 show that increasing pipe diameter from 17 to 19 mm, increased separation efficiency from 97.0 to 98.5, from 98.0 to 99.25, from 97.5 to 99.0 and from 97.0 to 98.0%. However, increasing separating pipe diameter more than 19 up to 22 mm, decreased separation efficiency from 98.5 to 95.0, from 99.25 to 96.0, from 99.0 to 93.0 and from 98.0 to 90.0%, under moisture contents of 81%, 75%, 71% and 69% for dark Roselle. On the other hand, increasing pipe diameter from 17 to 20 mm, leads to increase separation efficiency from 96.0 to 98.5, from 97.0 to 99.5, from 96.5 to 99.0 and from 96.0 to 98.0%. But, increasing pipe diameter more than 20 up to 22 mm, decreased separation efficiency from 98.5 to 95.5, from 99.5 to 97.0, from 99.0 to 96.0 and from 98.0 to 95.0 %, under moisture contents of 84%, 83%, 80% and 75% for the light Roselle. While increasing pipe diameter from 17 to 22 mm, increased separation efficiency from 97.5 to 30.0, from 98.0 to 40.0, from 99.0 to 50.0 and from 99.8 to 54.0%, under moisture contents of 84%, 83%, 80% and 75% for the white Roselle.

It is noticed that increasing pipe diameter higher than petal diameter resulted in low separation efficiency. However, decreasing pipe diameter lower than petal diameter, resulted in low separation efficiency, as the separating pipe penetrates the seedpods and damaged it which caused rots.

It is also noticed that whenever the separating pipe diameter was closer to petal diameter, resulted in high separation efficiency. So, the proper pipe diameters for increasing unit separation efficiency are 19, 20, 17 mm for dark, light and white Roselle, respectively.

As to the effect of span time on petal damage, results in Fig. 5 show that under pipe diameter of 17 mm, increasing span time from 1 to 2 days, increased unit separation efficiency from 97 to 98%. But increasing span time from 2 to 4 days, leads to decrease separation efficiency from 98 to 97%, for dark Roselle. While increasing span time from 1 to 2 days, increased separation efficiency from 96 to 97%. But increasing span time from 2 to 4 days, separation efficiency decreased from 97 to 96%, for light Roselle. On the other hand, increasing span time from 1 to 4 days, increased separation efficiency from 97.5 to 99.8%, for white Roselle.

Effect of pipe Diameter and Span Time on Specific Energy

Considering the effect of pipe diameter on the specific energy, Fig. 6 show that increasing pipe diameter from 17 to 19 mm, decreased the specific energy from 4.48 to 4.31, from 5.15 to 49.7, from 6.09 to 5.98 and from 7.58 to 7.41 kW.hr./Mg, but increasing separating pipe diameter more than 19 up to22 mm, decreased the specific energy from 5.37 to 4.31 from 6.57

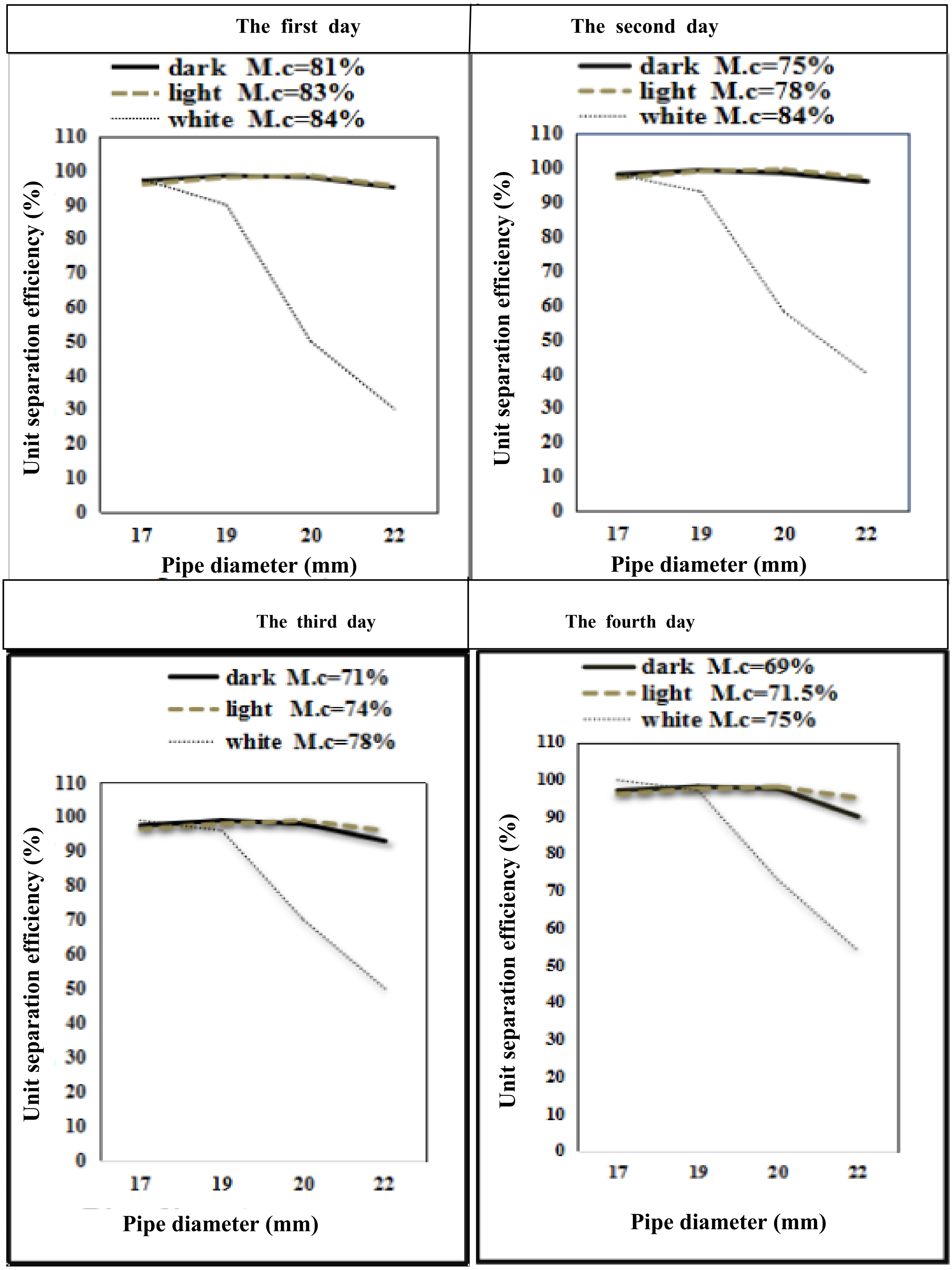


Fig. 5. Effect of pipe diameter and span time on separation efficiency

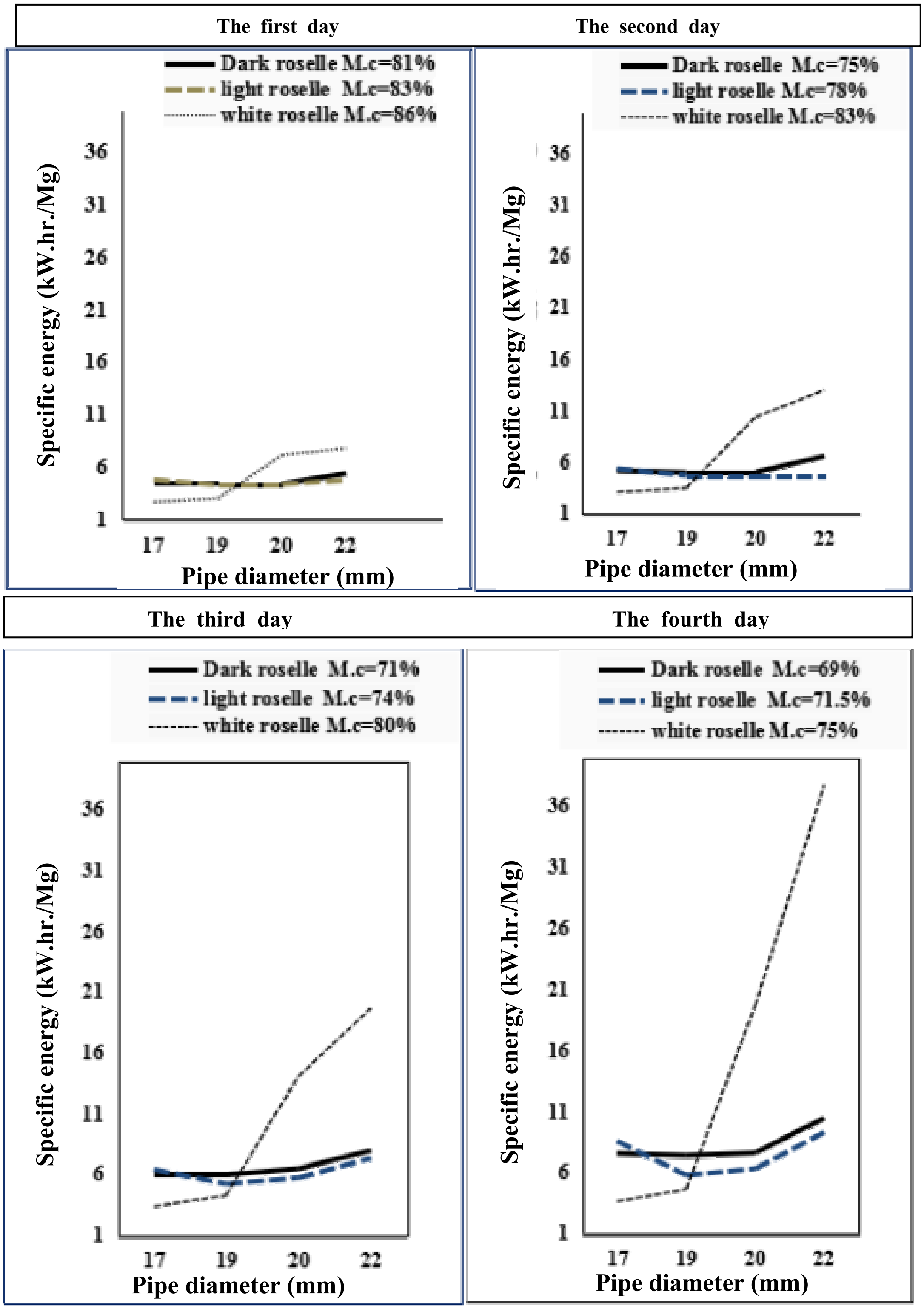


Fig. 6. Effect of pipe diameter and span time on specific energy

to 4.97, from 7.97 to 5.98 and from 6.46 to 7.41 kW.hr./Mg under moisture contents of 81, 75, 71 and 69%, respectively for dark Roselle. And also increasing separating pipe diameter from 17 to 19 mm, the specific energy decreased from 4.79 to 4.29, from 5,32 to 4.69, from 6.41 to 5.22, from 8.58 to 5.78 and from 8.58 to 5.78 kW.hr./Mg. But by increasing pipe diameter more than19 up to 22 mm, the specific energy increased from 4.29 to 4.75, from 4.69 to 4.74, from 5.22 to 7.33, from 5.78 to 9.29 and from 5.78 to 9.29 kW.hr./Mg under moisture contents of 84, 83, 80 and 75%, respectively for light Roselle.

Also increasing pipe diameter from 17 to 22 mm, the specific energy decreased from 7.81 to 2.68, from 13.00 to 3.08, from 19.66 to 3.38 and from 36.41 to 3.64 kW.hr./Mg, under moisture contents of 84, 83, 80 and 75%, respectively for white Roselle. The increase in specific energy by increasing pipe diameter is due to the increase in petal cutting resistance.

Results showed that increasing span time from 1 to 4 days under pipe diameter of 17 mm, increased the specific energy from 4.48 to 7.583 kW.hr./Mg, for dark Roselle, from 4.79 to 8.58 kW.hr./Mg, for light Roselle and from 2.68 to 3.64 kW.hr./Mg, for white Roselle. Also increasing span time from 1 to 4 days under pipe diameter of 19 mm, increased specific energy from 4.31 to 7.41 kW.hr./Mg, for dark Roselle, from 4.29 to 5.78 kW.hr./Mg, for light Roselle.

Effect of pipe Diameter and Span Time on Separating Cost

Concerning the effect of pipe diameter on separating cost, results in Fig. 7 show that increasing pipe diameter from 17 to 22 mm, increased separating cost from 392.00 to 581.00, from 413.00 to 641.00, from 448.00 to 747.00 and from 523.00 to 872.00 LE/Mg, under moisture contents of 81, 75, 71 and 69% for dark Roselle. While increasing pipe diameter from 17 to 19 mm, decreased separating cost from 427.00 to 402.00, from 449.00 to 413.00, from 490.00 to 418.00 and from 581.00 to 420.00 LE/Mg, but increasing separating pipe diameter more than 19 up to 22 mm, increased separating cost from 402.00 to 522.00, from 413.00 to 470.00, from 418.00 to 697.00 and from 420.00 to 826.00 LE/Mg, under moisture contents of 83, 78, 74 and 71.5% for light Roselle. On the other hand, increasing pipe diameter from 17 to 22 mm, leads to increase separating cost from 285.20 to 1176.00, from 296.00 to 1568.00, from 301.00 to 2092.00 and from 307.00 to 3766.00 LE/Mg, under moisture contents of 84%, 83%, 80% and 75% for the white Roselle. The major reason for decreasing separating cost by increasing pipe diameter is due to the increase in machine productivity.

As to the effect of span time on separating cost, results showed that increasing span time from 1 to 4 days under pipe diameter of 17 mm, increased machine separation cost from 392.38 to 523.44 LE./Mg, for dark Roselle, from 427.65 to 581.62 LE./Mg, for light Roselle and from 285.28 to 307.77 LE./Mg, for white Roselle. Increasing span time from 1 to 4 days under pipe diameter of 19 mm, increased separating cost from 418.47 to 529.27 LE./Mg, for dark Roselle, from 402.40 to 420.00 LE./Mg, for light Roselle and from 362.02 to 437.95 LE./Mg, for white Roselle.

Conclusion

A simple unit was manufactured for separating Roselle petal distinguished of high productivity, simple design and low damage.

The experimental results reveal that harvesting losses as well as total costs were minimum while separating efficiency was maximum under the following conditions:

Adjust cutting petal pipe diameters at 19 mm for dark Roselle 20 mm for light Roselle and 17 mm for white Roselle.

Operate the manufactured unit at the first day at moisture contents of 81% for dark Roselle, 83% for light Roselle and 84% for white Roselle.

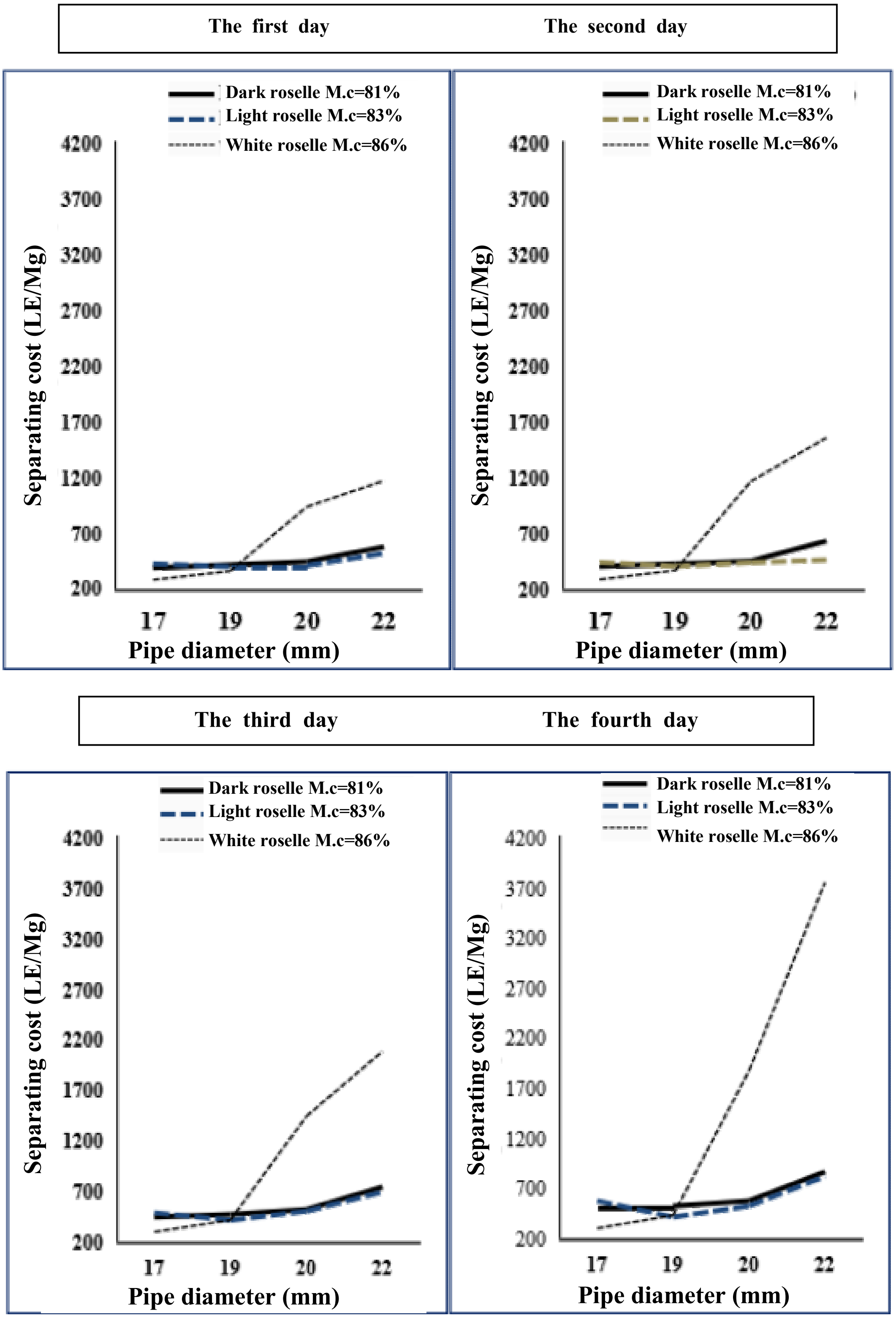


Fig. 7. Effect of pipe diameter and span time on separating cost

REFERENCES

Badr, S.E., E. Mousa and N. K. Ismail (2005). The engineering factors affected the Karkadia threshing. 13th Conf. Misr Soc. Agr. Eng., 14-15 December, 887- 896.

Chancellor, W.J. (1981). Substituting information for energy in agricultural. Trans. ASAE, Paper No. 0001-2351.

Eliwa, A.A. (2012). Developing a separation Roselle petal machine. Misr J. Ag. Eng., 29 (1): 463 – 480.

Hassan, N., M. Shimizu and M. Hyakum (2014). Occurrence of Root Rot and Vascular Wilt Diseases in Roselle (*Hibiscus sabdariffa* L.) in Upper Egypt. Mycobiology, 42 (4): 66-72, DIO:10.5941/MYCO.2014.42.1.66.

Ismail, A., E.H.K. Ikram and H.S.M. Nazri (2008). Roselle (*Hibiscus sabdariffa* L.) Seeds-Nutritional Composition, Protein Quality and Health Benefits. Global Science Books. Food, 2 (1): 1-16.

Kotb, F.E. (1997). Equipment design for separation of hibiscus fruit petals and its drying. Ph. D., Thesis, Agric. Mechanization Dept. Ain Shams Univ., Egypt.

Mohamed, B., A.A. Sulaiman and A.A. Dahab (2012). Roselle (*Hibiscus sabdariffa* L.) in Sudan, Cultivation and Their Uses. Bull. Environ. Pharmacol. Life Sci., 1 (6): 48 – 54.

Mohsenin, N.N. (1978). Physical Properties of Plant and Animal Materials. Gordon and Breach Sci. Publishers, New York, 1-28.

Naturl, E.V. and W. Kleinhaderner (2000). Organic Farming in the Tropics and Subtropics Exemplary Description of 20 Crops Hibiscus. Naturland EV 1st Ed. Germany. Nigeria. BIOKEMISTRI, 2003, 15 (1): 27-33.

Park, K.J., Z. Vohnikova and F.P. Brod (2002). Evaluation of drying parameters and desorption isotherms of garden mint leaves (*Mentha crispa* L.). J. Food Eng., 51 (3): 193-199.

Turner, O.O., W. Hill, A.D. Turner and W. Hill (2017). Sorrel harvesting machine with spaced apart rotating return and cutting drums moving in opposite directions at a throat there between US Patent, Paper No. 9-629-390 B1.

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تصنيع وتقييـــم أداء وحــــــدة مبســــــطة لفصــــــل ســــــبلات الكــركــديه

دعاء إبراهيم الدمرداش - محمد محمد مراد - تغريد حبشى أحمد

قسم الهندسة الزراعية – كلية الزراعة – جامعة الزقازيق - مصر

إن للكركديه أهميه كبري حيث يدخل في صناعه الحلويات، والصبغات الغذائية، وصناعة الأدويه المفيده لمرضي الضغط والسمنة كما يمكن استخدامه كمصدر للوقود الحيوي ويمكن أن يدخل في صناعه المبيدات الحشرية، تدور فكرة البحث حول تـصنيع وتقييم أداء وحدة مبسطة لفصل سبلات الكركديه لتحقيق أعلي إنتاجية وأقل فواقد من السبلات، لذا تم دراسة أداء هذه الوحدة علي ثلاثة أنواع من نباتات الكركديه: الغامق، والفاتح، والأبيض باستخدام أربعة أقطار متباينة لأنبوب الفصل ١٧، ١٩، ٢٠ و ٢٢ مليميتر وذلك علي مدار أربعة أيام متتالية بدءًا من وقت الحصاد حيث كانت نسبة المحتوي الرطوبي للأنواع الثلاث علي الترتيب الغامق، والفاتح، والأبيض ٨١، ٨٣ و ٨٤% في اليوم الأول ٧٥، ٧٨ و٨٣% في اليوم الثاني ٧١، ٧٤ و ٨٠% في اليوم الثالث ٦٩، ٧١,٥ و ٧٥% فى اليوم الرابع، تم تقييم هذه الوحدة علي أساس عدة عناصر تتمثل في الإنتاجية, الفاقد في السبلات, كفاءة الفصل, الطاقة المطلوبة للفصل، تكلفة الفصل للسبلات، ولتحقيق أعلى نسبه إنتاج وتقليل نسبة الفاقد من السبلات يجب مراعاة العوامل الآتية: استخدام أنبوب فصل ذي قطر ١٩مم للكركديه الغامق، استخدام أنبوب فصل ذو قطر ٢٠ مم للكركديه الفاتح، استخدام أنبوب فصل ذي قطر ١٧مم للكركديه الأبيض، تشغيل وحدة فصل سبلات الكركديه فى اليوم الأول للحصاد عند نسبة رطوبة ٨١% للكركديه الغامق، ٨٣% للكركديه الفاتح ، ٨٤% للكركديه الأبيض.

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