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The Determination of Variety Effect of a Simple Cotton Picking Machine on Design Parameters

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Abstract: This study was made in order to determine how much the type of cotton affects the design parameters such as vacuum pressure, suction speed and break-off force in a simple cotton picking machinery. The vacuum pressure, suction speed and curl break-off forces belonging to the cotton types of DPXxC//BixLa hybrid and Nazilli 84 which is still being developed in accordance with the mechanical harvesting were measured. The statistical relationships between measured design parameters and cotton variety were searched. It was observed that there is no statistical difference between types in aspect of suction speed and values of vacuum pressure where as the types differ in aspect of lock break-off force. The lock break-off force of the type of Nazilli 84 was been found lower than the kind which is still being developed. Although the break-off forces of cotton variety are different it is observed that suction speed of 2 m s^{-1} in average and a vacuum pressure of –5 kPa is sufficient for the locks to be broken off from the bolls.

Key words: Cotton, vacuum, suction speed, cotton picking machinery

Introduction

Cotton is an important and strategical agricultural product. One of the major problems faced with in cotton which is grown in different sizes of areas is harvest (Tunçer and Işik, 1999). In Turkey a great portion of cotton harvest is realised by human labor force. However the tendency of increase in labor costs leads the producers towards harvest with machinery (Sabanci and Işik, 1989; Evcim and Öz, 1997). The harvesting machinery used in Turkey are the big capacity ones running with generally mechanical principle. The cotton harvesting with big capacity machinery can be economical only in establishments with big production sites or establishments which has long duration for usage within the year (Evcim, 1996). It seems that this machinery can not be used in small areas because of their physical properties. Considering the current cotton facilities in Turkey it would be beneficial to develop a simple machinery decreasing the requirement for labor force. Whether the design parameters to be used in the development of machinery will vary in accordance with the types or not is an important knowledge which shall make design much easier.

Materials and Methods

The schematical appearance of cotton picking machinery designed has been illustrated in Fig. 1. The machinery consists of a picking edge of the brim diameter of which can be adjusted, a vacuum storage the below lid of which can be opened, a depot where the cotton harvested is collected and a vacuum unit imposed from a movable power source.

A simulation mechanism in Fig. 2 has been formed to determine the design parameters related with the machinery. In this mechanism is an electricity engine of 1 kW, a vacuum unit providing vacuum up to 0.025 $m^3 s^{-1}$ and –70 kPa's, two vacuum meters, two circular valves, a square wire strainer with the dimension of 1x1, an air channel consisted of PVC pipe and a material connecting apparatus. In the measurements a flow measure with telescopic probe with the measurement interval of 0,0001-195 $m^3 s^{-1}$, a dynamometer with the sensitivity of 0,001 and measurement interval of 0-2 kg, a vacuum meter with the sensitivity of –1kPa and measurement interval of 0 and –100 kPa were used.

The cottons used in the trials DPXxC//BixLa hybrid representing 5 lines formed by the combination hybrids of Deltapine DPX, Cocker 4104, Beliizvor and La 566 FN

Table 1: Averages belonging to the fiber and physio-mechanic properties

Physio-mechanical and fiber properties	Nazilli 84	DPXxC//BixLa
Dry lock mass (g)	1.161	1.11
Wet lock mass (g)	1.271	1.213
Lock moisture (%)	8.706	8.515
Number of seeds per lock	7.019	6.982
Carpel openness (mm)	39.958	37.236
Carpel depth (mm)	22.953	22.535
Carpel angle (degree)	40.969	39.537
Fiber length (mm)	26.667	27.300
Fiber strength (g.tex^{-1})	28.550	28.643
Fiber elongation (%)	10.567	10.210
Fiber fineness (micronaire)	5.617	4.697

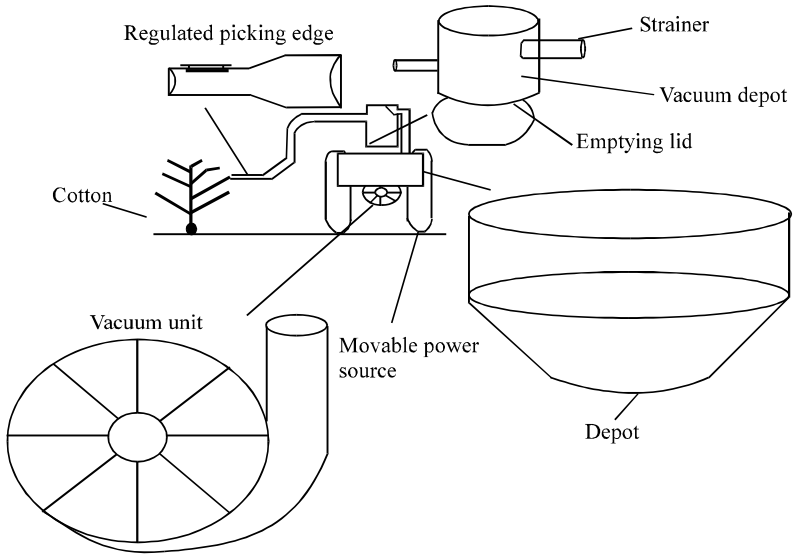

Fig. 1: Designed cotton picking machinery

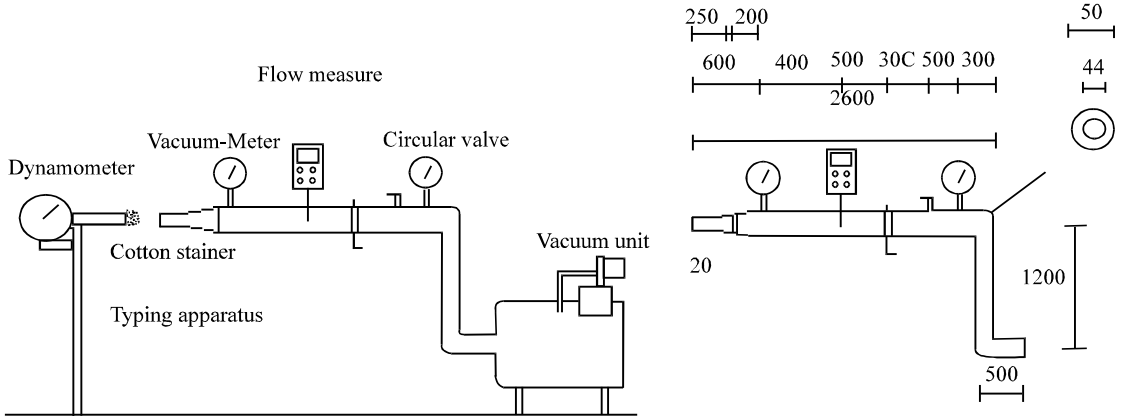

Fig. 2: Simulation mechanism

developed in accordance with the mechanical harvesting and the type of Nazilli 84. The averages of the values belonging to the physio-mechanical and fiber properties belonging to the varieties of cotton were presented in Table 1.

The properties of kinds have been given in literature (Kaynak *et al*., 2001).

The varieties of cotton used in trials were picked from the parcels grown as 3 repetitions in accordance with randomized bock desing trials. 450 cotton bolls consisting of 25 each repetition were picked in the harvesting period (15^{th} – 30^{th} October).

The bolls were tied to the dynamometer on the simulation mechanism as a rigid in a way resembling the method indicated in the literature (Dilbaeck and Quisenberry, 1979). The locks in four carpel inside of bolls were broken off with the effect of vacuum by opening circular valve in air the channel. The break-off force, vacuum pressure and air flow values were measured at the moment the locks were broken off from the carpel. The locks were prevented from going through the channel with a strainer inserted in air channel. Totally 1800 trials have been made.

The adjusted picking edge in the designed cotton picking machine must be used by the worker. As this moving unit was pulled closer or pushed further towards locks under the control of the worker this case was reflected to simulation mechanism. As the breaking off of the locks were taken as the base, the distance between the edge of picking and locks was not taken into consideration. In the trials the diameter of the smallest hole of the picking edge through which the locks pass was taken as fixed. The breaking off value measured in terms of mass with the

calculations made after measurements was converted into the force by using the equation of

$$F = mg \qquad 1$$

the flow value measured in air channel was converted into the value of suction speed in air channel by using the equation of

$$V = 1.273 \frac{Q}{D^2} \qquad 2$$

This value was converted into value of suction speed at the edge point of the channel by using the equation of

$$V_S = \frac{V.D^2}{D_e^2} \qquad 3$$

Results and Discussion

The averages of the measured design parameters were given in Table 2 in accordance with the variety of cotton. The values of vacuum pressure, suction speed (V_S) and break-off force are respectively –4,132 kPa, 1.676 m s^{-1}, 0.393 N in the hybrid of DPXxC//BixLa and 3.528 kPa, 1.620 m s^{-1}, 0.284 N in the type of Nazilli 84. The values of break off force match with the literature data (Yelin, 1985). The variance analysis was made to determine whether there is difference between the varieties in aspect of design parameters. The results obtained were presented in Table 3.

When we observe Table 3, we see that there is difference in aspect of lock break off force statistically between DPXxC//BixLa hybrid and the variety of Nazilli 84. There is no difference between repetitions.

The force of lock break off of the type Nazilli 84 is much lower than the hybrid type of DPXxC//BiLa. This case is a positive indicator for the appropriateness of the hybrid type of DPXxC//BiLa which is being developed for the mechanical harvesting. As the lock break off force is not the direct running value of the machinery designed the difference likely to occur between types will not affect the design of machinery directly. The fact that there is no statistical difference between vacuum pressure and suction speed (V_S) forming the running values of designed machinery shows that the machinery can be used in different ways.

Although the break off forces of varieties of cotton which used in research are different from each other we can say that the lock in the cotton bolls can be broken off with the suction speed of average 2 m s^{-1} and a vacuum pressure of –5 kPa.

Table 2: The repetition averages belonging to design parameters

	DPXxC//BixLa Hybrid population average			
Design parameters	1	2	3	Average
Vacuum pressure (kPa)	-3.737	-4.462	-4.197	-4.132
Suction speed (m s^{-1}) (V_S)	1.692	1.689	1.644	1.676
Force of lock break-off (N) (F)	0.378	0.367	0.431	0.393
	Nazilli 84			
Design parameters	1	2	3	Average
Vacuum pressure (kPa)	-3.690	-3.575	-3.318	-3.528
Suction speed (m s^{-1}) (V_S)	1.575	1.583	1.703	1.620
Force of lock break-off (N) (F)	0.238	0.262	0.350	0.284

Table 3: Variance analysis chart belonging to design parameters

	Repetition	Factor-A	Error	General
Design parameters	2	1	2	5
Vacuum pressure (kPa)	0.054 ns	0.548 ns	0.116	0.178
Suction speed (ms^{-1}) (V_S)	0.001 ns	0.004 ns	0.005	0.003
Force of lock break-off (N) (F)	0.004 ns	0.018 *	0	0.005

ns: minor *: important in the level of 5%

The values of suction speed and vacuum pressure found at the end of trials are below the values of suction speed and vacuum pressure to be obtained from a pneumatic planting machine (Önal, 1995). That's why some revisions can be made during the development of cotton picking machine and the vacuum units of pneumatic planting machines can be used.

The farm trials should be made to show the effect of designed picking machines on human labor force and efficiency as well as their analysis in the aspect of economics in accordance with the harvest made with human labor force and big harvest machinery.

References

Dilbaeck, R.E. and J.E. Quisenberry, 1979. Stromproof Boll in Upland Cotton. Crop. Sci., Vol:19, pp: 567.

Evcim, Ü., 1996. Cotton Pickers and Adaptation of The Turkish Cotton Culture to Mechanized Harvest (Pamuk Toplama makinalari ve Türkiye Pamuk Tariminin Makinali Hasada Uyarlanmasi. Büyük Menderes Ovasi ve Deltasinda Tarim ve Çevre Sorunlari Sempozyumu. Bildiri Kitabi, s:53, Söke).

Evcim, Ü. and E. Öz, 1997. Determination of Quantitativ Performance of Machine Picking on different Cotion Varieties (Farkli Pamuk Çeşitlerinin Makinali Hasadinda Kantitatif Performansin Belirlenmesi. Tarimsal Mekanizasyon 17.Ulusal Kongresi. Bildiri Kitabi 2.Cilt,s:790, Tokat).

Kaynak, M.A. *et al*., 2001. The Determination of Important Agronomic and Technological Properties in Populations Obtained by Combination Crossing in Cotton Pamukta (*Gossypium hirsutum* L.) Kombinasyon Melezlemesi ile Oluşturulan Populasyonlarda Önemli Agronomik ve Teknolojik Özelliklerin Saptanmasi. GAP II. Tarim Kongresi, Bildiri Kitabi 2.Cilt, s:849, Şanliurfa).

Önal, I., 1995. Planting and Fertilizing Machinery (Ekim,Bakim, Gübreleme Makinalari, E.Ü. Ziraat Fakültesi Yayinlari No:490. Izmir).

Sabanci, A. and A. Işik, 1989. Variation of The Harvesting Costs of Cotton and Future of The Mechanical Harvesting in Çukurova Region (Çukurova Bölgesinde Pamuk Hasadinda Toplama Bedeli Değişimleri ve Makinali Hasadin Geleceği. Tarimsal Mekanizasyon 12. Ulusal Kongresi. Bildiri Kitabi, s: 35, Tekirdağ).

Tunçer, K. and A. Işik, 1999. Mechanical Cotton Harvest Enterprises and Results in Turkey (Makineli Pamuk Hasadi ve Türkiye'deki Gelişmeler. Türk Dünyasinda Pamuk Tarimi Lif Teknojisi ve Tekstil 1. Sempozyumu, Bildiri Kitabi, s: 209, Kahramanmaraş).

Yelin, D., 1985. The Research of Heritability of Yield and Agronomical Characters Related Machine Harvest on Half Diallel Populations of Five Different Cotton Varieties in The *Gossypium hirsitum* L. (Gossypium hirsutum L. Türü Içinden Beş Pamuk Çeşidinin Yarim Diallel Melez Populasyonlarinda, Verim ve Makinali Hasada Ilişkin Tarimsal Özelliklerin Kalitimi Üzerinde Araştirmalar. Doktora Tezi. Ç.Ü. Fen Bilimleri Enstitüsü).