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Short Communication

Silique Picking Force for Canola

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ABSTRACT

The silique picking force of three canola varieties (*Brassica napus* L.), at three stems moisture content, three amounts of fertilizer and three pull out velocities were measured. Results showed that all used factors had significant effect at 1% confidence on axial ward picking force of siliques. Silique picking force increased with increasing stem moisture content. Data indicated no relationship between silique and petiole lengths with their picking force, while these two quantities were independent. Dimensions of siliques showed that the amount of urea fertilizer and type of variety had significant effect on length of petiole, length, thickness and width of siliques at 1% confidence. Urea fertilizer had no influence on the amount of seeds in canola siliques. © 2010 Friends Science Publishers

Key Words: Silique; Canola; Picking force; Strength

INTRODUCTION

Physical and mechanical properties of canola silique play an important role in designing all the calculations and processes (Diepenbrock, 2000). It seems that designing a new head for canola combine, which its operation is based on picking capsules and leaving the shrub in soil, will lead to decrease in canola seed losses. Pod picking combines, which are completely different from normal combines with respect to their structure and operation, have been introduced for crops and legumes, these combines have been designed in different models but their operation is based on picking the pods or the seeds of the crops (Tado *et al.*, 1998). A pod picking combine has been manufactured to harvest peas, which by picking only peas pods from the plant, decreased losses (Behroozilar & Huang, 2002). Previous studies found that needed force and energy to pick agricultural products is a function of moisture content of product and the force orientation (Behroozilar *et al.*, 1999). To measure the fruit picking force of crops, direct and indirect methods could be used. In indirect method, a centrifugal or acceleration-related force is imposed to the pod *e.g.*, in chickpea (Khazaei *et al.*, 2004). In direct method, the pod by means of a special clamp, which is attached to a force gage axially is been pulled until it is detached from the stem (Mesquita & Hanna, 1995). Bruce *et al.* (2002) used a random impact test, involving controlled agitation of samples of 20 canola siliques to measure their breaking response and fitting model. Khazaei *et al.* (2002) showed that by increasing in pulling out velocity of pyrethrum flower, required force and consumed energy would be increased. In the present study, picking force of three varieties of canola siliques in the direction of silique petiole axial ward needed to detach the capsules was measured. Furthermore petiole length, silique length, width, thickness of siliques, the amount of seeds in each silique and their relations were evaluated.

MATERIALS AND METHODS

Comparison of the siliques picking forces was conducted for three varieties of canola (*Zarfam*, *Opera* & *Okapi*) at three stems moisture content (40.5%, 52% & 60.2% wet weight basis) three amounts of urea fertilizer (250, 400 & 550 kg ha^{-1}) and three picking velocities (50, 100 & 150 mm s^{-1}). Seed moisture content was about 8-11% wet basis. Same condition was achieved by equilibrating the siliques in an atmosphere of constant relative humidity and temperature until no further weight change occurred. Urea fertilizer was applied to plants in three phases' foliation, stemming and blooming.

Moisture content of stems was measured in 103^{0}C for 24 h with minimum weight of 25 g (ASABE Standards, 2006). In order to measure the picking force of canola siliques, a silique holding clips was designed and Instron Testing Machine, Hounsfield Universal, measured force. Siliques were placed inside the fixed clamp from their petioles. Before starting tests, petiole length, silique length, width and thickness of siliques were measured and after the silique was detached from the stem, the amount of seed inside were determined. A digital micrometer measured three dimensions of canola silique (length, width, thickness & petiole length) with 0.01 mm accuracy to evaluate the influence of urea fertilizer on silique dimensions.

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A completely randomized design was used with 40 replications. The statistical package *MINITAB* Ver. 13.2 (*Minitab* Inc., State College, Pa.) was used. Means were compared using LSD test (P<0.05).

RESULTS AND DISCUSSION

Results showed that variety, stem moisture content, pulling out velocity, the amount of urea fertilizer, interactive effects of variety-velocity, variety-stem moisture content and velocity-fertilizer had significant (P<0.01) effect on silique picking force. The mechanical properties of pods, which are hygroscopic due to lingo-cellulosic in nature, are influenced by their moisture content (Bruce *et al.*, 2002). It was therefore, necessary to ensure that every sample of siliques was tested at the same moisture condition. The experiments conducted during three days showed that decrease in stem moisture content levels was not sensible and had no effect on silique picking strength (decrease in stem moisture content was about 3%). Means showed that *Opera* with 5.164 N needed the highest force to pick siliques and *Okapi* with 3.234 N required the lowest (Table I). It means that silique picking strength of each variety was different, because of difference in morphology and petiole texture properties (Morgan *et al.*, 1998). Kadkol *et al.* (1985) have reported a significant difference between bending shatter resistance of different variety of canola and soybean pods, respectively. With increasing pulling out velocity, silique picking strength decreased (Table I). As the velocity increased from 50 to 150 mm s^{-1}, the required force decreased 63%, 62% and 59% in *Opera*, *Zarfam* and *Okapi*, respectively. Khazaei *et al.* (2004) showed the same trend for chickpea pod. On the contrary Khazaei *et al.* (2002) reported that picking force increased with increasing pulling out velocity in orange and pyrethrum flower, respectively.

The maximum silique picking force was proportional to the 550 kg ha^{-1} urea fertilizer. The force value for 550 kg ha^{-1} fertilizer was 4.79 N and for 400 kg ha^{-1} was 3.93 N. Means showed that there was no significant (P>0.05) difference on silique picking force between 250 and 400 kg ha^{-1} fertilizer (Table I). Increase fertilizer doze increased silique picking force. For every fertilizer treatments at 50 mm min^{-1} velocity and the other two pulling out velocity there is a significant (P<0.05) difference (Table I).

Canola variety had significant (P<0.01) effect on length, width, thickness and petiole length of siliques. By counting the seeds inside each silique, it was observed that urea fertilizer has no effect on the amount of siliques seed but it has affected the weight of each 1000 seeds (Table II). Saleem *et al.* (2001) showed that the yield and yield attributes were significantly influenced both by row spacing and nitrogen levels. The average number of seeds in each silique in canola was 24 similar to that reported by Morgan (1982). There was a relation between siliques length and number of seeds with 89% coefficient of determination (Fig. 1). Correlation coefficient showed that, there was no relation between silique and petiole lengths with picking force of siliques, while these two quantities were independent. In addition, Kadkol *et al.* (1985) showed that there was a significant positive relationship between size (length & weight of the silique) and bending strength parameters in different *Brassica* genotypes.

Table I: Effect of pulling out velocity on silique picking force

Varieties	Velocity, mm s^{-1}		
	50	**100**	**150**
Zarfam	7.14 b	2.97 e	2.74 e
Opera	8.60 a	3.58 d	3.30 d
Okapi	5.38 c	2.24 f	2.07 f
Urea (kg ha^{-1})			
250	6.60 b	2.75 d	2.54 d
400	6.53 b	2.72 d	2.51 d
550	7.98 a	3.32 c	3.07 c
Stem m.c. (%)			
40.5	3.1 c	2.2 d	2.25 d
52	5.3 b	2.6 d	2.4 d
60.2	7.2 a	3.4 c	3.1 c

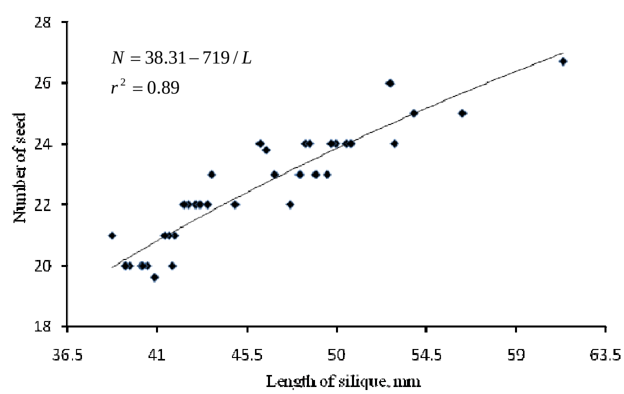
a-f Similar letters in each factor, show no significant difference (LSD, 5%)

Table II: Silique physical properties

Varieties	Urea fertilizer (kg ha^{-1})	Petiole length (mm)	Length (mm)	Thickness (mm)	Width (mm)	1000-seed mass (g)
Zarfam	250	17.76 c	45.9 bc	3.962 b	3.22 e	4.50 a
	400	17.00 c	44.9 c	4.376 a	3.39 e	4.60 a
	550	18.04 c	38.03 e	4.399 a	3.63 d	4.60 a
Opera	250	20.54 b	49.95 a	3.328 d	4.51 abc	4.65 a
	400	22.41 a	48 ab	3.37 cd	4.63 ab	4.65 a
	550	21.50 ab	49.36 a	3.40 cd	4.69 a	4.70 a
Okapi	250	20.93 b	49.85 a	3.36 cd	4.38 c	4.70 a
	400	20.88 b	47.5 ab	4.54 a	4.60 ab	4.65 a
	550	18.43 c	42.1 d	3.54 c	4.48 bc	4.75 a

a-e Similar letters in each columns, show no significant difference (LSD, 5%)

Fig. 1: Relationship between silique length and seeds inside



CONCLUSION

Canola variety is an important factor in silique picking force. As the pulling out velocity increased, silique picking force decreased, while silique picking force increased with increasing stem moisture content. Urea fertilizer had no specific trend for silique picking force. No certain existed between urea fertilizer and petiole length; length, width and thickness of siliques. Also no relationship existed between silique dimensions with its picking force.

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