

Process protocol for mechanical separation of fruit core and seeds from apple fruits and evaluation of their germination potential

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ABSTRACT : Apple seeds separated from apple pomace are utilized for raising apple nurseries by orchardists. Owing to crushing of seeds during juice, extraction the germination capacity is very low with poor seed vigour. An attempt was made to develop a hand tool for separation of core from the fruit for its use in separation of seeds. Seeds were evaluated for their germination capacity for use in raising apple nurseries. On the basis of fruit and core dimensions, mechanical corer consisting of coring tube internal diameter 22.1 mm, fruit holding cup and plunger device for moving the coring tube was developed. The coring efficiency of the mechanical apple corer (73.4 kg/h) was found about 5.12 times higher as compared to manual coring method (14.3 kg/h). Pretreatment of fruit core by using pectinase (1 %) enzyme for 24 hours was optimized for softening of the fruit core prior to seed separation. The softened fruit core was found suitable for passing through the mechanical seed separator for separation of seeds. The average seed extraction rate in mechanical seed separator (311.53 g/h) was found 18 times higher as compared to manual seed separation method (17.28 g/h) with negligible seed damage. The germination potential of the seeds separated through mechanical seed separator was found to be 89.9 % as compared to only 65.3 % germination recorded in seeds separated from apple pomace left after juice extraction. Thus, method of separation of apple seeds can be adopted by the orchardists as well as fruit processing units to serve the apple industry for raising rootstocks.

Key Words: Apple, Fruit and core dimensions, manual seed separation, mechanical apple corer.

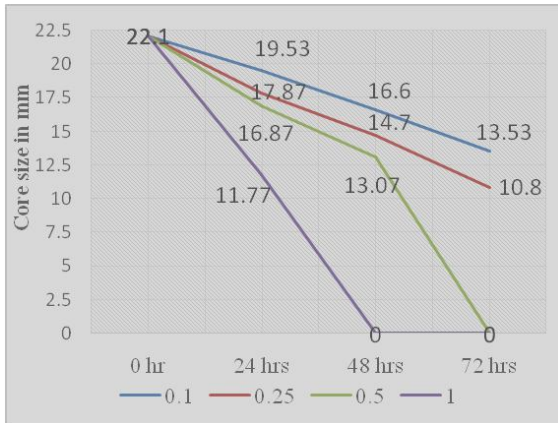


Fig.-1 : Effect of different concentrations (%) of Pectinase enzyme on softening of apple core at different intervals.

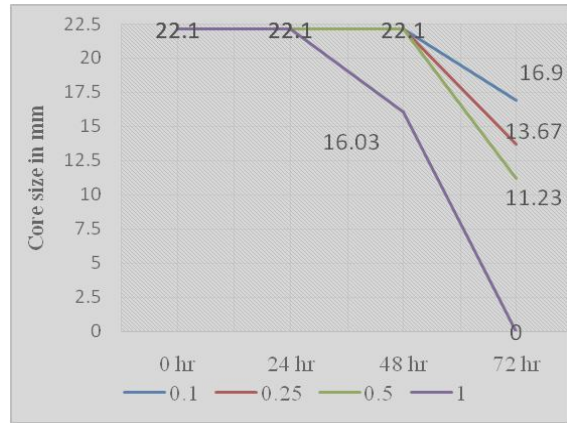


Fig.-2 : Effect of different concentrations (%) of Amylase enzyme on softening of apple core at different intervals.

Table-1 : Size parameters of whole apple fruit, fruit core and seed of different cultivars of apple.

Apple Cultivar	Horizontal fruit dia (mm)	Vertical fruit diameter (mm)	Core length (mm)	Core diameter (mm)	Seed Length (mm)	Seed Breadth (mm)	Seed Thickness (mm)
Golden Delicious	62.1	57.0	53.4	17.9	7.91	4.02	2.13
Granny Smith	72.1	68.9	67.5	21.9	7.86	4.18	2.57
Gold Spur	62.3	60.3	58.5	17.9	8.53	4.50	2.37
Spartan	62.0	56.0	52.3	17.8	8.06	3.87	2.23
Red Gold	63.1	55.2	52.0	17.7	7.65	4.18	2.28
Royal Delicious	67.6	60.4	57.3	21.0	7.11	4.07	2.09
Culled Apple	58.0	52.9	49.9	15.9	7.82	4.18	2.17
CD_{0.05}	2.37	3.49	2.89	0.41	0.50	NS	NS

Table-2 : Effect of manual and mechanical method of fruit coring on the efficiency of removal of fruit core and fruit damage in different cultivars of apple.

Method Cultivar	Quantity of fruits cored/h		No. of fruits damaged/h		Mean (Cultivar)		Mean (C) fruits damaged/h
	*C ₁ (kg/h) Manual coring (h)	**C ₂ (kg/h) Mechanic- al coring	C ₁ (No. of fruits/h)	C ₂ Mechani- cal coring	kg/h	No. of fruits/h	
Golden Delicious	15.0	75.3	11.0	4.0	45.2	454	7.5
Granny Smith	19.0	110.0	13.0	7.0	64.5	451	10.0
Gold Spur	13.0	65.3	10.7	4.7	39.2	471	7.7
Spartan	12.7	64.7	8.3	5.0	38.7	467	6.7
Red Gold	12.0	65.0	7.0	2.7	38.5	467	4.8
Royal Delicious	15.3	78.0	12.0	7.0	46.7	445	9.5
Culled Apple	13.3	55.3	12.3	6.7	34.33	487	9.5
Mean (Method)	14.3	73.4	10.7	5.3			
*C ₁ Manual coring **C ₂ Mechanical coring							
Quantity of fruits cored (kg/h)		Quantity of fruits cored (No. of fruits/h)		Number of fruits damaged/h			
CD _{0.05}		CD _{0.05}		CD _{0.05}			
Cultivar (C)	2.47	Cultivar (C)	7.30	Cultivar (C)		2.42	
Method (M)	1.32	Method (M)	3.90	Method (M)		1.29	
(C X M)	3.49	C X M	10.31	(C X M)		NS	

Table-3: Efficiency of seed separation from apple core in seed extraction machine *viz-a-viz* manual operation in different cultivars of apple.

Cultivar	Wt. of seeds separated manually (M_1^* , g)	Time taken in min	Wt. of seeds separated in seed extractor (M_2^{**} , g)	Time taken in min	Wt. of Seed lost in seed extractor, ($M_1 - M_2$) g	Wt. of Seed damaged in seed extractor, tor, g	Seed damage (%), M_2	Seed Extraction efficiency (M_2 , g/h)	Seed Extraction efficiency (M_1 , g/h)
Golden Delicious	15.6	51.0	14.5	3.13	1.10	0.35	2.42	277.6	18.35
Granny Smith	18.9	44.0	18.3	2.74	0.60	0.24	1.31	400.2	25.78
Gold Spur	13.2	53.0	12.5	2.16	0.70	0.25	1.99	347.2	14.94
Spartan	12.0	54.0	11.5	3.16	0.50	0.30	2.61	218.3	13.33
Red Gold	16.2	51.0	15.5	3.19	0.70	0.16	1.03	291.5	19.06
Royal Delicious	12.8	46.0	11.9	2.30	0.90	0.22	1.83	312.1	16.7
Culled Apple	15.0	61.0	14.3	2.58	0.66	0.21	1.49	333.8	14.75
CD_{0.05}	1.24	3.60	1.26	0.24	NS	0.06	0.40	41.69	0.10

(Mean feed rate of apple fruit core was optimized to 22.14 kg/h with a water flow rate of 1.6 lt/min. in mechanical seed separator)

M_1^* Seeds separated manually M_2^{**} Seeds separated in seed extractor

Table-4: Effect of method of seed separation on seed germination, seedling length, seedling dry weight, seed vigor index (I and II) and Seed germination index in apple seeds.

Seed type	Seed Germination (%)	Seedling length (cm)	Seedling dry weight (mg)	SVI-I	SVI-II	G.I
S₁(Core seeds)	89.3	13.3	0.25	1,190.1	22.5	18.0
S₂(Core seeds)	89.9	13.7	0.25	1,227.6	22.7	18.3
S₃(Pomace seeds)	65.3	13.6	0.26	882.1	15.7	18.2
CD_{0.05}	1.60	0.18	NS	12.972	3.39	NS

S1- Seeds separated manually from apple core; **S2-** Seeds of apple core removed through tomato seed separator;

S3- Pomace seeds: seeds separated from apple pomace left after juice extraction; **G.I-** Seed germination index.

