

CLUSTER ANALYSIS AMONG NINE COTTON GENOTYPES

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ABSTRACT

The field trial was conducted at Qwshtapa district , Grdmala village, which is 30 km far from center of Erbil city to compare between nine genotypes of cotton (*Gossipum hirsutum* L) during the growing season 2016, the genotypes were (Coker 310, Lachata 'Iraqi genotypes ' Cafko, Dunn 1047, Montana, Stone Ville ' USA genotypes ', Bakhtegon, Khdorda , Vanamin Iranian genotypes) using randomized complete block design (RCBD)with three replicates. any fertilizers were not added to the field during the research and Irrigation was done using Statistical analysis of the traits shown significant differences among genotypes , Coker 310 obtained the highest value for number of fruiting brunches, number of Bolls plant⁻¹·Boll weight (g), seed yield plant⁻¹, ginning% and oil% with values of (8.93 ,29.27,4.23, ,77.67, 39.87 and 28.33) respectively. Lashata genotype recorded highest value of protein and linoleic acid % which were (34.82 and 63.68) % respectively. Depending on growth stage, agronomic characteristics and their quality the genotypes were discerning to three main clusters, the first one included (Lachata and Stone Ville) genotypes, while the second clusters indicated only Cafko genotype and the third cluster included (Coker 310, Dunn 1047and, Montana, Bakhtegon , Khdorda and Vanamin) genotypes.

Keywords: Cotton genotypes, yield, seeds quality, Cluster analysis.

محمود وآخرون

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التحليل العنقودي بين تسعة تراكيب وراثية من القطن

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المستخلص

أجريت تجربة حقلية في مزرعة قوشتبه، قرية كردملا على بعد 30 كم من وسط محافظة أربيل للمقارنة بين تسعة انماط وراثية من القطن (*Gossipum hirsutum* L) خلال موسم النمو 2016، الانماط المستخدمة في البحث كانت الاصناف العراقية (كوكر 310 ولاشاتا)، الاصناف الامريكية (كافكو، دون 1047، مونتانا و ستون فالى) اما الانماط الوراثية الايرانية كانت (خودورا، بكتاكون، فانامين) في تصميم القطاعات الكاملة العشوائية بثلاث مكررات، واستخدم نظام الري بالتنقيط عند تنفيذ التجربة. بينت نتائج التحليل الاحصائي وجود فروقات معنوية بين الانماط المدروسة وتبين ان الصنف كوكر 310 تفوقت في صفات عدد الافرع الثمرية، عدد الجوز /نبات، متوسط وزن الجوز(غم) حاصل البذ ور/ نبات، تصافى الحليج ونسبة الزيت بالقيم (8.93, 29.27, 4.23, 77.67, 39.87 و 28.33) على التوالي. بينما سجل الصنف لاشاتا اعلى القيم في نسبة البروتين ونسبة حامض اللينوليك بالقيم 34.82(و 63.68)على التوالي. اظهرت نتائج التحليل العنقودي للانماط الوراثية ترتيبها في ثلاث مجموعات رئيسية، المجموعة الاولى شملت لاشاتا و ستون فالى، المجموعة الثانية شملت كافكو فقط اما المجموعة الثالثة فضمت الانماط المتبقية (كوكر 310، دون 1047، مونتانا، بكتاكون، خودورا و فانامين) والتي فصلت بحسب صفات النمو، الحاصل و النوعية.

الكلمات المفتاحية: الانماط الوراثية للقطن، الحاصل، النوعية، التحليل العنقودي.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) regards as a white gold, which is occupying a prominent position in oil and textile industry, it serves as a backbone of the countries that made it as cash crops, and is a significant source of foreign exchange earnings (1). Cotton is the second most important oilseed crop in the world (2). The oil of cotton seeds regards as the preferred vegetable oil, that produces the most flavorful potato chips on the market. The hydrogenate is not necessary for increasing its oil stability (3). The growth and seed cotton production per unit area is affected by the following factors: Genotypes, sowing time, soil status, and environmental conditions (4). The yield of cotton was affected significantly by genotypes and sowing dates (5). On the other hand (6) referred that genotypes have a significant role in production of cotton crop, there were highly significant differences among genotypes for all qualitative and quantitative traits. (7) reported from their study on three genotypes of cotton that there were e significant differences for number of bolls and its components (seed and lint). From a comparisons study among six genotypes (8) stated that the genotype Lachata was superior in seed yield, boll weight and ginning out turn with the values of (4.20 Mg ha⁻¹, 5.25 g and 3.38%) respectively. The degree of variation in growth and dry matter partitioning was explored among nine cotton genotypes of diverse growth habit and how these may affect crop maturity. Because cotton is an indeterminate species, the timing of crop maturity is largely determined by the capacity

of the plant to continue the production of new vegetative organs and the associated fruiting sites (9). The results obtained from the study on four cultivars (CIM-499, CIM-473 CIM-496 and CIM-506) of upland cotton that there were significant differences between the cultivars in seed yield the highest value was (2.45), while the lowest value was (1.20 kg ha⁻¹)(10) .Since there are little studies about comparison among different American , Iranian and local genotypes ,for this reason this study was conducted to focus on the effect of different genotypes on yield , yield components and oil quality of nine cotton genotypes.

MATERIALS AND METHODS

The field experiment was carried out during summer growing season 2016 at Qwshtapa district, the village of Grdmala 30 km far from center of Erbil city, with GPS reading of 360° ON and 44001 E, 0411359, 03997002 UTM 44 03 °, 413.8 m above sea level E using randomized complete block design (RCBD) with three replicates. Nine cotton genotypes were used which two Iraqi genotypes (Coker 310 and Lachata), four USA genotypes (Cafko, Dunn 1047, Montana and Stone Ville) and three Iranian genotypes (Bakhtegon, Khordora and, Vanamin) The area of each plot was 6 m² (3*2m), the distances between rows were 70 cm and plant to plant was 25 cm so each plot contains 32 plants. On 30th April, the cotton seeds were sown uniformly using seed rate of 25 kg ha⁻¹. The soil properties were recorded in table(1).

Table 1. Some physico-chemical properties of the studied soil.*

Physical Properties		Particle Size Distribution		Value	
	Sand			118 g kg ⁻¹	
	Silt			432 g kg ⁻¹	
	Clay			450 g kg ⁻¹	
Textural Name				Silty Clay	
Chemical Properties		Value	Chemical Properties	Value	
	pH	7.86	Total Nitrogen	0.80 g kg ⁻¹	
	ECe	0.50 dS m ⁻¹	Available – P	9.3 mg kg ⁻¹	
	CEC	22.87 Cmolc kg ⁻¹	Total CaCO ₃	250 g kg ⁻¹	
	Organic Matter	9.70 g kg ⁻¹	Active CaCO ₃	15.55 g kg ⁻¹	
	Iron	2.98 mg kg ⁻¹	Copper	0.80 mg kg ⁻¹	
	Manganese	2.77 mg kg ⁻¹	Zinc	0.50 mg kg ⁻¹	
Soluble cation and anion					
Chemical Properties		Value	Chemical Properties	Value	
	Potassium	1.14 mmol L ⁻¹	Chloride	2.30 mmol L ⁻¹	
	Magnesium	1.55 mmol L ⁻¹	Bicarbonate	3.50 mmol L ⁻¹	
	Sodium	0.95 mmol L ⁻¹	Carbonate	0.00 mmol L ⁻¹	
	Calcium	2.50 mmol L ⁻¹	SO ₄ ²⁻	0.86 mmol L ⁻¹	

* (11)

The thinning of plants was on 16th June; Irrigation was done using drip irrigation methods (DIM), which is one of the technical measures to increase water use efficiency. Under this method, water is delivered directly to the root zone of the crops using pipe networks and emitters. This method is entirely different from the conventional (11), the amount of water applied was 1 L .hr⁻¹, all other agricultural practices were done whenever necessary. Randomly 10 plants were taken from each treatment at the mature stage (opening 60% of bolls) for measuring and collecting different parameters, in depending on Fattah (9). Some traits were recorded including plant height (cm), number of bolls per plant, boll weight (g), weight of 100 seeds(g) and yield of cotton seeds (kg ha⁻¹), The cotton bolls were harvested according to genotypes that were cultivated separately, finally the cotton seed calculated in unit kg per hectare. The 100 seeds were taken from each treatment and measured in gram).

Ginning out turn (GOT)

Before the ginning, seed cotton samples were air dried. Dusts and inert matter were removed from samples and then weighed and ginned separately manually. The lint obtained from each sample was weighed and its percentage was calculated by applying the following formula.

$$\text{Ginning out turn (GOT)} = \frac{\text{Weight of lint}}{\text{weight of seed+lint}} \times 100 \quad (12)$$

The oil was determined by Soxhlet extraction apparatus using hexane according to the methods described by Mahmood et al. (13). The Total Nitrogen was determined using the Kjeldahl method then the protein percentage was determined as follow:

Protein% = N% × constant value which equal to 6.25 Statistical analysis was done using SPSS program version 25 for comparing between means using Duncan's multiple range

test at probability ($p \leq 0.95$) (14). Cluster analysis was conducted between studied genotypes using XLSTAT-Premium Program to obtain homogenous groups by agglomerative hierarchical clustering (AHC) and principal component analysis (PCA), to show the similarity and dissimilarity between genotypes (15).

RESULTS AND DISCUSSION

This study showed significant results indicating varying genetic diversity of the genotypes for the studied characters such as, plant height, number of fruiting brunch, number of bolls per plant, boll weight and seed yield per plant and boll yield ha⁻¹. Table 2 shows significant effect between genotypes on plant height, the highest value (125.40 cm) was recorded for Lachata, While the lowest value (103.13cm) recorded for Bakhtegon genotype this results was in agreement with those recorded by Saeed et al. (16). The highest values has for number of fruiting branch, number of bolls Plant⁻¹, bolls weight (g) and seed yield plant⁻¹ were recorded from Coker 310 with the values of(8.93,29.27,4.23 and 77.67)respectively, while the lowest values of them (7.20,19.00,3.58and 60.23) were obtained for Khorda genotypes respectively ,these results explain that the genotype is the main factor affected on the above traits (17), or it means that genotypes are differing in their adaptation to Erbil environments. The same Table, shows the significant variation in biological yield among the genotypes, Lachata was recorded the highest (3.58) Mg ha⁻¹ biological yield, while Vanamin genotypes recorded the lowest (2.13) Mg ha⁻¹. This could be due the difference in yield genetic potentiality of the studied genotypes (18). The dynamics of dry matter production and reproductive demand may also have a significant impact on the yield of different genotypes (9).

Table 2. Effect of genotypes on some growth and yield characteristics

Genotypes	Plant height (cm)	No. node till branch(g)	No. vegetativbr unch	No. Fruiting brunch	No. Boll Plant ⁻¹	Boll weight (g)	Seed Yield Plant ⁻¹ (g)	Biological Yield Mg ha ⁻¹
Coker 310	105.07bc	4.87a	3.33a	8.93 a	29.27a	4.23 a	77.67a	3.39a
Lachata	125.40a	4.33a	3.87a	8.13 ab	22.80ab	3.66ab	68.91ab	3.58 a
Cafko	118.53ab	4.53a	3.67a	8.40 ab	20.27ab	3.62 b	63.58bc	3.16 a
Dunn 1047	107.80bc	4.20a	4.53a	8.8 ab	21.53ab	3.32 b	67.91ab	2.92 ab
Montana	103.15c	5.33a	4.27a	7.33 ab	17.40b	3.45 b	61.88bc	2.87 ab
Stone ville	115.00abc	4.67a	4.27a	8.60 ab	19.40b	3.72 ab	64.55bc	2.81 ab
Bakhtegon	103.13c	5.27a	4.2a	7.33 ab	16.47b	3.84 ab	74.03ab	2.68 ab
Khdorda	105.47bc	5.40a	3.4a	7.20 b	19.00b	3.58 b	60.23c	3.02 ab
Vanamin	110.80bc	4.60a	4.28a	7.60ab	17.73b	3.56 b	50.76a	2.13 b

Table 3 Refers to the significant differences among the studied genotypes, Bakhtegon recorded the highest value for seed index and fiber plant⁻¹ with the values of (6.40 and 8.65) respectively. While their lowest values (5.13 and 6.46) were obtained from Cafko and Montana genotypes respectively, since the seed index was mostly affected by genotypes because it depends on velocity of seed growth which considered genetic characters and to be the main goal from cotton production (16).

Table 3. The comparison between genotypes on some field characteristics

Genotypes	Seed index		Seed %		Ginning		Fiber/plant
Coker 310	5.30	b	63.91	ab	39.87	a	6.64 b
Lachata	5.52	ab	64.60	a	35.40	b	6.48 b
Cafko	5.13	b	60.13	b	36.09	ab	6.55 b
Dunn 1047	5.63	ab	64.01	ab	35.99	ab	6.89 b
Montana	5.42	ab	62.55	ab	37.45	ab	6.46 b
Stone ville	5.58	ab	61.99	ab	38.01	ab	7.02 b
Bakhtegon	6.40	a	60.91	ab	39.09	ab	8.65 a
Khdorda	5.56	ab	62.65	ab	37.35	ab	6.64 b
Vanamin	5.28	b	62.13	ab	37.87	ab	6.74 b

The results in Table 4 shows significant effect of cotton genotypes on oil % the highest and lowest values (36.33 and 18.33 %) were obtained for Coker 310 and Stone Ville genotype respectively, these differences contributed to their genetic properties. While the highest values for both protein % and linoleic acid% (34.82 and 63.68) % were obtained for Lachata genotype and the lowest values(28.47 and 26.90) % were recorded for Vanamin and Cafko respectively. These results are in agreement with (20) they indicated that

The highest seed% and net ginning out % (64.80 and 39.87) % were recorded from Lachata and Coker 310 genotypes respectively, while their lowest values (60.13% and 35.40) Lachata and Cafko genotypes respectively. These results were in agreement with Others (19), they found that differences in ginning may be due to differentiation between genotypes and total cotton lint yield which reflect positively on this characteristics as mentioned by (16).

oil% and protein % in cotton were (18-26 %) and (32-36%) respectively. It is appear from the same Table that highest and lowest values of oleic acid were found from Stone Ville and Cafko genotype respectively. On the other hand the highest and lowest values of linolenic content were recorded from Dunn 1047 and Vanamin genotypes.

Table 4. The comparison between genotypes on some quality characteristics

Genotypes	Oil %	Protein%	Oleic%	Linoleic%	Linolenic%
Coker 310	28.33a	29.25d	15.96g	53.34b	0.51c
Lachata	25.00b	34.82a	35.94b	63.68a	0.40c
Cafko	26.00ab	31.32c	15.88g	26.90 h	1.46b
Dunn 1047	24.33bc	33.22ab	27.70d	45.87d	2.25a
Montana	20.67d	34.13a	28.61c	45.53d	0.58c
Stone ville	19.67d	34.76a	47.56a	48.30c	1.69b
Bakhtegon	24.67bc	33.71a	21.79f	33.55g	1.47b
Khdorda	24.00bc	31.73bc	35.71b	36.75f	0.39c
Vanamin	22.00d	28.47d	24.59e	39.94e	0.33c

Fig 1 explains the results of statistical analysis using Dendrogram, which classified the genotypes to three main clusters, the first one included (Lachata and Stone Ville), the second clusters included only Cafko genotype and the third cluster included the remain genotypes which were (Coker 310, Dunn 1047and,

Montana, Bakhtegon, Khdorda, and Vanamin). The genotypes within the same cluster are similar in the studied characters. It explains that the Dunn1047 and Montana genotypes are much more similar than Vanamin in the same clusters.

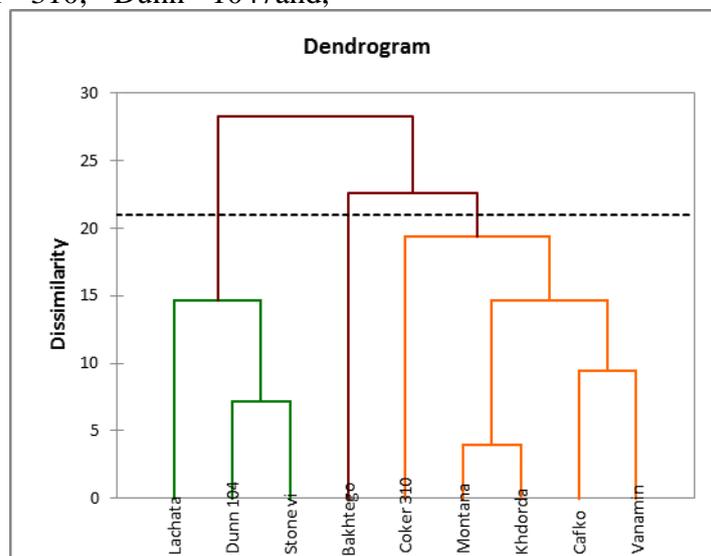


Fig 1. Dendrogram obtained from a cluster analysis of the genotypes

Table 5 shows the proximity matrix of this research, which refers to similarity and dissimilarity, the highest value (43.32) refers to higher dis-similarity. Relationship between the two Genotypes Lachata and Cafko, the same dis-similarity were obtained between

Lachata and Bakhtegon (41.68) it means there are highest differences between them while the value of 8.32 refers to the similar relation between Dunn 1047and, Montana as mentioned

Table 5. The proximity matrix (Euclidean distance)

	Coker 310	Lachata	Cafko	Dunn 1047	Montana	Stone Ville	Bakhtegon	Khdorda
Coker 310								
Lachata	31.988							
Cafko	32.382	<u>43.316</u>						
Dunn 1047	20.465	27.837	25.593					
Montana	23.691	32.388	28.358	<u>8.324</u>				
Stone ville	38.877	26.526	39.763	22.365	23.053			
Bakhtegon	25.943	<u>41.677</u>	22.954	18.701	19.715	35.419		
Khdorda	28.645	34.434	26.199	13.297	13.321	21.111	17.751	
Vanamin	23.268	32.914	18.512	10.825	12.138	26.274	18.296	14.299

Fig 2 Shows some observations on the studied genotypes it's clear that at the right side the closest distance mean more similarity in the same cluster there are different manner

between the genotypes stone Ville and Dunn104 was in the positive side while Cafko and Lachata was negative .this explanation is the same for the second cluster.

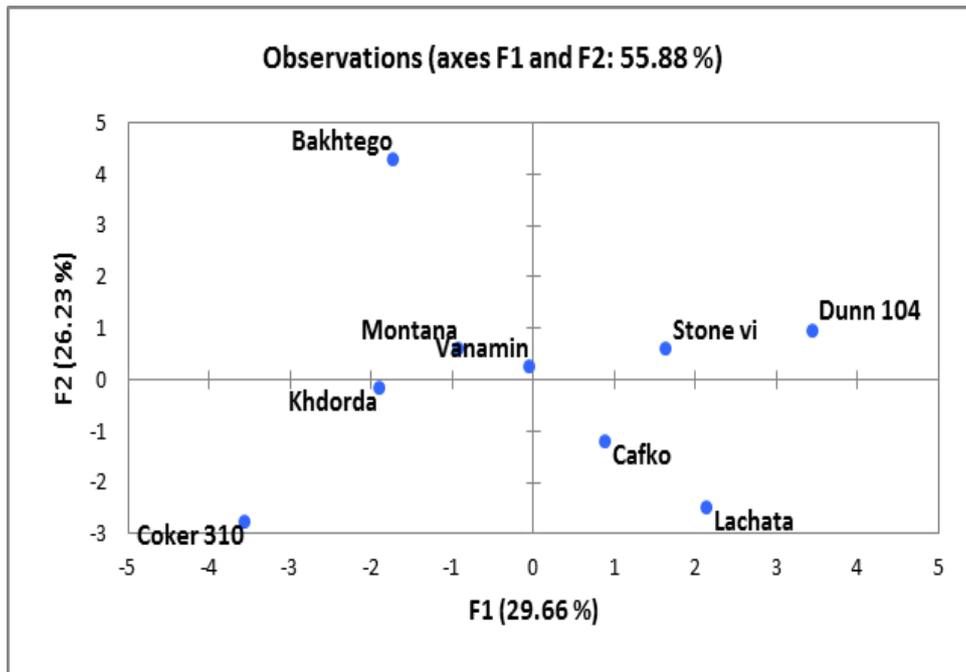


Fig 2. Cluster analysis of the characteristics of the genotypes

There is a very high correlation between seed yield and the number of the ball per plant, plant height, seed % and linoleic acid as mentioned in Fig 3. Clustering variables can

be a useful way to discover which traits or groups of traits tend to similar or vary together in a population.

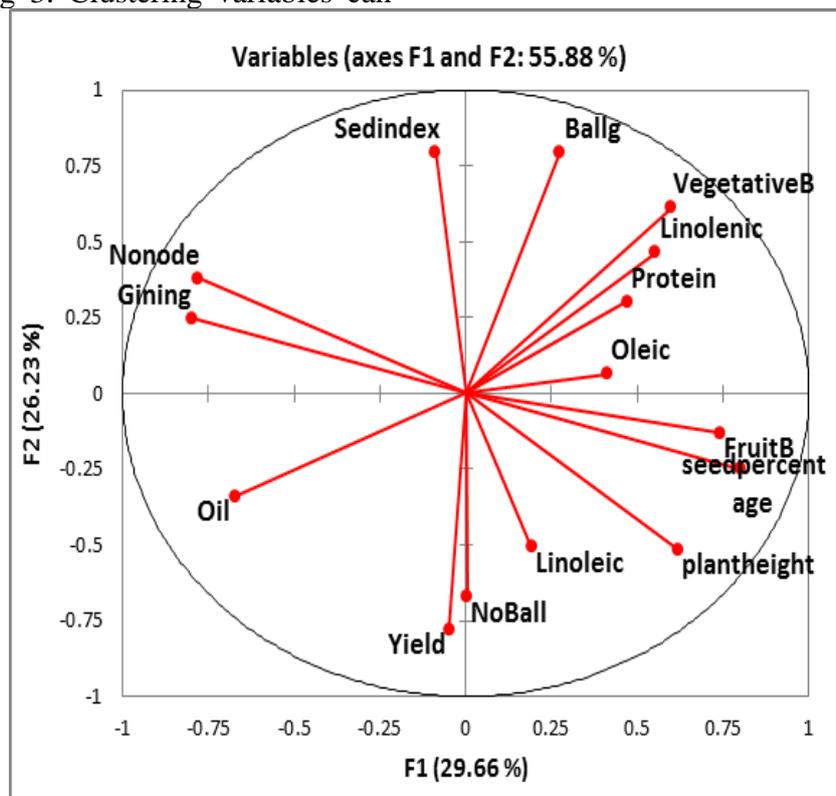


Fig 3. Cluster analysis between variables in the comparison study

In Figure 4 the genotypes and variables are merged and give a different explanation. The variables close to the center there will not be significant differences between them for example in leachate and Kafko genotype is closest in yield, seed%, and fruiting brunch

...etc variables. Protein seed, oleic and linoleic is more close to Dunn 1047 and Stone -Ville genotype, any of the variables are close mean there is a positive reaction between them and the other side has a negative reaction with the first one.

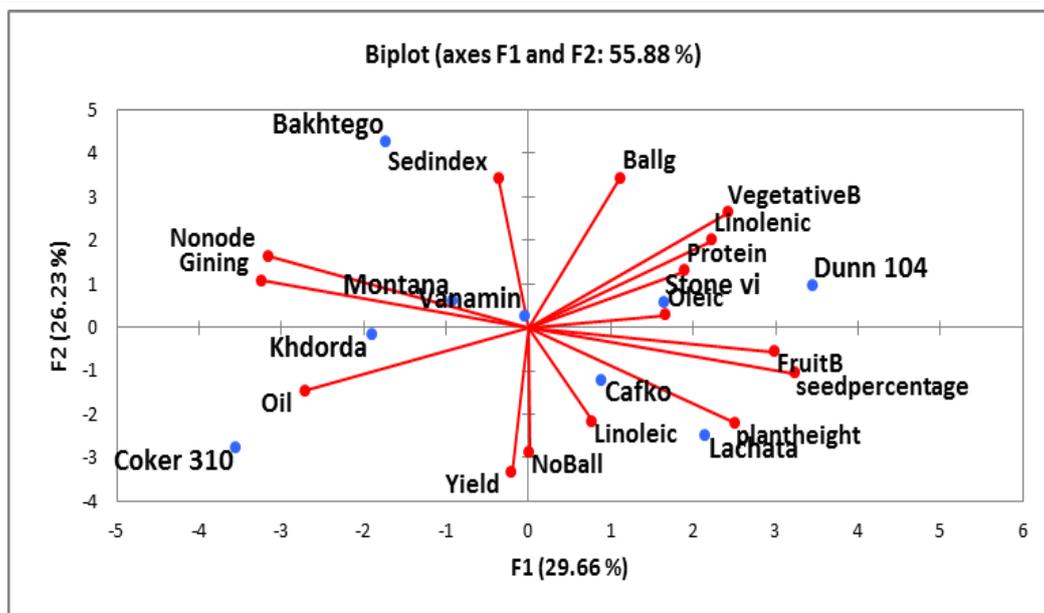


Fig 4. Cluster analysis between variables in the comparison study

Conclusion

The studied genotypes had shown significant differences in most traits, the Lachata and Coker 310 genotypes were the most superior in most quantitative and qualitative characters comparing with other cultivars.

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