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Preliminary characterization of germplasm collected in Apulia and Albania

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Summary

This work reports the preliminary results attained by the Section of Genetics and Plant Breeding of the DiBCA, University of Bari, stemming from surveys and collections of genetic resources in Apulia and Albania. Areas of collection, agricultural species and the kind of genetic resources collected are illustrated. In particular, a preliminary study on the variation of the main bio-agronomic characters of a melon collection (*Cucumis melo* L.) is also reported. The species described is one of the main vegetable crops in the South of Italy where it is grown in open and cover field. The interest in this cucurbit resides in the presence of several genetic resources to be protected from genetic erosion in the regions involved in the Interreg II Project. The said collection has been established with genetic resources (accessions, landraces) of Italian and Albanian origin and belonging to the three botanic varieties of the species '*cantalupensis*', '*reticulatus*' and '*inodorus*'. The results achieved are satisfactory both for the safeguard of plant biodiversity and for the wide genetic variability collected which lays the bases for further selection plans useful for the breeding of the species.

Key word: *Cucumis melo* L., genetic resources, plant biodiversity.

1. Introduction

A previous work (Ricciardi and Filippetti, 2000) highlighted the extent of genetic erosion, mainly that of Mediterranean agricultural species. Furthermore, the concept of genetic erosion was also provided (Scarascia Mugnozza, 1974) through examples of how the restriction of genetic variation could induce economic, social and environmental damages.

The above-cited work also examined the causes leading to genetic erosion (Scarascia Mugnozza, 1974; Muchiru, 1985; Goodrich, 1987; WCMC, 1992; Dahl and Nabhan, 1992; World Resources Institute et al., 1992; Gomez-Campo, 1992; UNEP, 1993; Guarino, 1995) and reviewed (Fahy et al., 1984; Perrino, 1990; 1997; Harlan, 1992; Sparling et al., 1993; Brush, 1995; Iwanaga, 1995; Barlow and Tzotsos, 1995; Eyzaguirre and Iwanaga,

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1996; Adams, 1997; Engelmann, 1997; Pagiola, 1997; Bellon *et al.*, 1997; Qualset *et al.*, 1997; Withers and Engelmann, 1997; Jana, 1999; Hammer *et al.*, 1999; Filippetti and Ricciardi, 2000; 2001) the most significant actions in order to reduce the threat of genetic erosion in the light of the nationalization of genetic resources as sanctioned by Rio Convention (1992).

Among the strategy, the 'ex situ' conservation of genetic resources through the establishment of germplasm collections is of considerable importance (Simmonds, 1979). In this respect, the present work reports information on the work of germplasm collection conducted by the Section of Genetics and Plant Breeding of DiBCA in Apulia and Albania within the framework of Italy-Albania Cooperation Program named: "Interreg II". Furthermore, results of a preliminary study on the variation of some bio-agronomic traits of a *Cucumis melo* L. collection are reported.

Melon is one of the major vegetable crops in the South of Italy and in Apulia where it is grown in open and cover field. Hybrid seeds are used both to exploit their positive heterotic effects on productivity and mainly to obtain uniform products and plants resistant to the most virulent pathogens (Ferrari *et al.*, 1998). The use of hybrids (generally improved in other countries and sources of disease) is one of the causes of genetic erosion that should be limited by protecting the local genetic resources available in many southern regions and in Apulia as well (Ricciardi and Filippetti, 2000). In Apulia, there are some typical melon-growing areas where several genetic resources of this cucurbit are still available (Ricciardi et al., 2000). The morphological characters of the plant and fruit of these genotypes show a wide variability; however, their quality and resistance to the most common pathogens necessitate further assessment.

The results concern the three botanical varieties of the species, i.e. *cantalupensis*, *reticulatus* and *inodorus*, and report notices on an interesting local product called "barattiere" (a melon consumed when unripe) used in the provinces of Brindisi, Bari and in Salento. The cultivation of this Cucumis in the open field or in the greenhouse even with salt water provides satisfactory returns to local farmers who aim at a further spread of the crop and a better marketing of the product at national and European level.

2. Materials and methods

The research started in 1999/2000 and it was mainly based on the collection of germplasm of several species interesting for the Mediterranean area. In order to speed up the acquisition time and study of potentially interesting genetic resources, this activity also was conducted by requesting collection seeds, genetic resources and breeding material to public research boards involved in the safeguard of the Mediterranean biodiversity (Germplasm Institute and Industrial Horticulture Institute, CNR Bari, Italy); by growing the material already available and stored at the Section of Genetics and Plant Breeding of DiBCA, University of Bari; through direct exploration and collections of the genetic resources available in Apulia and Albania.

The species under study belong to cereals (in particular durum wheat); grain legumes (broadbean, chickpea, lentil, chickling vetch, bean); several vegetable plants (tomato, pepper, eggplant, broccoli rab, cauliflower, zucchini, chicory, lettuce, parsley, string-bean, cucumber, melon, “carosello”, “barattiere”) (Tab. 1).

The areas interested to exploration are located for Apulia to the north of Bari, the coastline between Bari and Savelletri, a part of Brindisi province; for Albania the agricultural districts of Tiranë, Durrës, Kavajë, Fier, Lushnje, Berat, Elbasan, Vlorë, Korçë, etc. In particular, the genetic resources of 'barattiere' were acquired along the coastline, in the province of Brindisi and from some sites near “Canale di Pirro” (Putignano, Selva di Fasano, Alberobello) an area where this crop, presumedly was first grown.

The germplasm collected was catalogued and the data reported concerning the species, type of genetic resource, acquisition date, place of collection, name of the donor, potential and/or peculiar characteristics of the genotype.

For some materials (tomato and melon), in the year 1999/2000, a preliminary evaluation of the variability was possible for some of the major bio-agronomic characters.

The analysis of the melon variability (*Cucumis melo* L.) is reported in the present work and it was carried out on 121 *Cucumis melo* L. genotypes belonging to the botanical varieties *inodorus*, *reticulatus* and *cantalupensis* from 'ex situ' collections already owned by the Section of Genetics and Plant Breeding of DiBCA and from collections made in Apulia and Albania areas.

The genotypes were grown following a completely randomized design on the Experimental Farm 'Martucci' of the Agricultural Faculty located in

Tab. 1 Species, origin and number of the main genetic resources collected in the program "Interreg II". (1)

SPECIES	ORIGIN			
	APULIA	ALBANIA	OTHER	TOTAL
Vicia faba L.	20	2	80	102
Cicer arictinum L.	18	3	60	81
Lens culinaria L.	15	1	50	66
Lathyrus sativus L.	10	--	30	40
Phaseolus vulgaris L.	--	15	--	15
Vigna unguiculata L.	1	8	--	9
Capsicum annuum L.	2	16	--	18
Solanum melongena L.	--	5	--	5
Lycopersicon esculentum Mill.	8	30	--	38
Cucumis melo L. *	40	49	68	157
CAROSELLO	8	--	--	8
BARATTIERE	15	--	--	15
Cucurbita pepo L.	8	1	--	8
Brassica rapa L.	2	--	--	3
Cichorium intybus L.	6	--	--	6
Brassica oleracea L. var. botritis	3	--	--	3
Eruca sativa Mill.				
Diplotaxis tenuifolia L.	9	--	--	9
T O T A L	165	130	288	583

(1) Some limited samples regard: chickling vetch, okra, chich pea, pumpkin, persley, lettuce, spinach, cucumber and chard.

* *Data regarding all botanical varieties of Cucumis melo L.*

Valenzano (Bari). Before to transplanting, on May 15, 2000, all the genotypes were sown in honey-comb polystyrene containers covered with peat moss and soil mix. Transplanting was made onto a soil fertilized with 12 q/ha of a ternary fertilizer 9-6-14, placing plants 1 meter apart on the row and 2 meters between the rows.

During the cultivation, plants were topped (at the 4th leaf), fertilized with 40 units of nitrogen and irrigated. Pesticide treatments were often made in order to halt powdery mildew infections and attacks by aphids and mites. The harvest of genotypes started on July 15 and ended on August 25 for later genotypes, mainly for those belonging to the botanical variety *inodorus*.

The following bio-agronomic characters were recorded for all genotypes: early ripening (number of days from transplanting to harvest), number of fruits per plant, mean weight of fruits, mean yield per plant, length to width

ratio of the fruit, thickness and color of the peel, thickness and color of the flesh, soluble solide content.

The biometric data were statistically analyzed in order to estimate the main descriptive statistics and the correlation coefficients between characters.

3. Results and discussion

The activity of exploitation and germplasm collection conducted within the Interreg II programme led to the acquisition of 295 samples of local genetic resources from Apulia (165) and Albania (130). As reported in Tab. 1, the total number of samples is 583 if the above material is added to the resources already collected and available at the Section of Genetics and Plant Breeding of DiBCA and coming from other Mediterranean regions.

The germplasm collected belongs to 27 species. For some of them, the number of samples is still low, but it will surely rise in the forthcoming months. A rather high number of samples has already been taken for the broadbean (22); Figs. 1 and 2 show the seeds of two landraces ('Locale di Putignano' and an Apulian selection of 'Violetta di Policoro'); for the chick pea (21), which shows a high variability concerning seed color and pods size; for lentil (16); chickling vetch (10); bean (15: they all come from Albania); pepper (18); tomato (38) and melon (89) (Fig. 3).

For the latter species, the cited number, concerning the three botanical varieties *inodorus*, *reticulatus* and *cantalupensis*, shall be completed by some samples of 'carosello' and 'barattiere' (23) (Fig. 4) collected just in Apulia, where they are acquiring a considerable economic relevance as typical local produce raising the interest of national and European markets.

The said table substantiates that genetic resources are collected also for species which are important just for the two regions of the project. This is true for okra for Albania, broccoli rab, kale and rocket salad for Apulia.

As mentioned in the chapter 'Materials and Methods', a preliminary evaluation and propagation of the genetic materials have been made in the current year (the material was introduced early in April 2000). Only for the genetic resources of *Cucumis melo* L. (*inodorus:* 93; *reticulatus:* 18; *cantalupensis:* 10) an analysis of variation on the main bio-agronomic characters was performed. The *inodorus* types, that belonged to accession collected in Southern Italy (46), Apulia (37) and Albanian (10) landraces, were analyzed in relation to their different origin. For *reticulatus* and *cantalupensis* botanical varieties, due to the low number of samples collected, the analysis was performed on the total number of genotypes of

each botanical type. The following discussion mainly concerns *inodorus* genotypes.

It shall be underlined that the cultivation of the melon germplasm was negatively influenced by a very warm year and by several pathogens. Tab. 2 reports the means relative to the eight bio-agronomic characters detected on the genotypes of the three botanical varieties. On the average, *reticulatus* genotypes were earlier than cantaloupes and *inodorus* melons. The latter produced a lower number of fruits per plant (2.8), although the mean weight of the fruit was higher (2.3 kg). The highest number of fruits per plant was detected for cantaloupes (4.2 kg) despite a lower mean weight (1.7 kg) very similar to that of muskmelon (1.9 kg).

Tab. 2 Means, standard errors and coefficient of variation estimated for 8 bio-agronomic traits recorded on 93 genotypes of Cucumis melo L. var. "inodorus", 18 "reticulatus" and 10 "cantalupensis".

CHARACTERS	*Cucumis melo* L.					
	"Inodorus"		*"Reticulatus"*		*"Cantalupensis"*	
	x ± s.e.	C.V. (%)	x ± s.e.	C.V. (%)	x ± s.e.	C.V. (%)
Ripening days	72.5 ± 8.3	11.5	67.7 ± 6.6	9.7	71.6 ± 6.2	8.7
Fruits per plant (number)	2.8 ± 1.6	55.1	3.2 ± 1.8	55.2	4.2 ± 2.3	54.0
Fruit weight (kg)	2.3 ± 1.0	44.5	1.9 ± 0.7	39.2	1.7 ± 0.8	50.0
Yield per plant (kg)	6.5 ± 4.4	68.0	5.9 ± 3.6	61.7	6.9 ± 4.7	68.0
Flesh thickness (cm)	3.4 ± 0.7	20.0	3.2 ± 0.7	20.9	3.4 ± 0.7	20.6
Peel thickness (mm)	7.1 ± 2.3	33.0	7.1 ± 2.6	36.0	5.6 ± 2.3	42.0
Fruit length to width ratio	1.5 ± 0.4	29.5	1.2 ± 0.3	22.0	1.1 ± 0.2	17.2
Soluble solid content (°Brix)	7.7 ± 2.8	36.4	8.2 ± 3.0	36.4	9.0 ± 2.8	31.6

Yield per plant proved to be very similar for *inodorus* and *cantalupensis* types (6.5 and 6.9 kg respectively); in contrast, the mean yield per plant of muskmelon equalled 5.9 kg.

Among botanical varieties, differences statistically not significant were estimated for the mean thickness of the peel and of the fruit flesh. An exception was reported for the peel thickness of cantaloupe melons that was thinner (5.6 mm) than that of *inodorus* and muskmelons.

The mean values of fruit length to width ratios, confirmed that passing from *cantalupensis* and *reticulatus* (spherical) types to *inodorus,* the fruit takes a more oblong shape, typical of winter melon cultivars.

The soluble solide content, a character which is highly influenced by the environmental effects (potassium content of soils and potassium-based fertilizations), was rather limited for all types. On average, a higher value was estimated for cantaloupes (9.0° Brix), whereas the winter types recorded a lower value (7.7°). The soluble solid content is an important character for the breeding of melon in that in many countries marketable melons must exceed the minimum values of 9-10° Brix (Ferrari *et al.*, 1989).

The results concerning the variation of characters, which are preliminary since they refer just to the genetic resources so far acquired, have shown a satisfactory and wide variation.

The variability analysis performed on the botanical variety *inodorus* (Fig.5) showed the presence of very early (mainly in the Albanian material) and late genotypes (local varieties). This feature is crucial for winter melons since they are consumed till Christmas thanks to their slow ripening even when they are picked up from the plant (Bianco, 1990). Therefore, it is useful to have genotypes whose earliness is differentiated in order to broaden the period of the product supply on the markets.

Over 95% of genotypes showed a number of fruits between 1 and 4. The Albanian material produced 1 to 2 fruits per plant (90% of the Albanian genotypes), whereas some genotypes (8.8%) bearing 5-6 fruits per plant were identified only among the accessions.

The highest mean fruit weight was recorded in the accessions (2.4 kg) and in the varieties (2.3 kg). As for the accessions, the most frequent class included melons whose weight ranged between 2.3 and 2.8 kg, in contrast with local varieties, in which 70% of the genotypes had a weight between 1.7 and 2.8 kg. Among the accessions, it also was possible to observe genotypes (4.3%) with a mean fruit weight between 4.7 and 5.2 kg.

As for the yield per plant, and given the close and negative association between the number of fruits per plant and the fruit weight ($r = -0.85^{**}$), a wide variability was recorded with rather low yields performed by Albanian genotypes and higher production obtained for accessions and local varieties (26.1 and 35.1%). These resources also showed genotypes with plant yield of 9-11 kg per plant.

The shape of melons (Fig. 6) resulted highly variable, from spherical to oblong mainly in the local varieties and Albanian material. This also showed melons with a thicker peel, whereas 43.2% of the local varieties had a thinner rind. Among accessions, it was possible to highlight genotypes (6.6%) with a thinner peel (2 to 3.4 mm).

The higher frequency for the flesh thickness was comparable for the three genetic resources studied and comprised between 3.0 and 3.4 cm. Just in the accessions and local varieties, it was possible to point out genotypes (about 12%) with a flesh thickness between 4.0 and 4.4 cm.

The soluble solid content in most Albanian local varieties was rather low and never exceeded 6 °Brix. Values higher than 9.0, a minimum threshold for the marketing of melons, were reported in 30.4% of accessions and 46% of the Apulian local varieties.

Figures 3, 4, 5, and 6 report the histograms of frequency for the eight characters studied, concerning the genotypes *reticulatus* and *cantalupensis*. As said, the preliminary results obtained for these genotypes must be confirmed by further observations on a higher number of samples.

As to the earliness of *reticulatus* (Fig. 7), the results showed that about 40% of genotypes ripened 65 to 69 days after transplanting. 67% of the genotypes examined produced 3 to 4 fruits per plant with a mean weight between 1.7 and 2.8 kg. Yield per plant was highly variable since it was obtained from genotypes producing melons with a weight variable between 1.0 and 2.9 kg per plant (11%) and 9.0 to 10.9 kg per plant.

The fruit length to width ratio substantiated that 83% of the genotypes falled within the class interval between 1.0 and 1.4 (Fig. 8). Only 5% of genotypes had low values of the peel thickness (below 5 mm), whereas 60% of the examined material had minimum values (3.0 cm) of the flesh thickness.

As to the soluble solid content, also for the genotypes "*reticulatus*" a wide variation was estimated: 33.5% of the genotypes showed values above 9 °Brix.

Despite the limited number of samples, also for "*cantalupensis*" genotypes, a good distribution of the variability was observed. An exception was represented by the number of ripening days in that very early genotypes have not been reported with respect to the genotypes belonging to the botanical varieties "*inodorus*" and "*reticulatus*". In contrast, some cantaloupe genotypes have been identified in relation to their yields that fall within the class of higher frequency (11-12.9 kg per plant).

The most frequent fruit shape (80% of genotypes) was spherical (fruit length to width ratio between 1.0 and 1.4), whereas the soluble solid content showed minimum values between 6 and 7.4 °Brix (40% of distribution), highlighting genotypes with a refractomteric residue equal to or above 10.

Based on the results obtained, it may be stated that the research has pointed out a wide variation of the major bio-agronomic characters of *Cucumis melo* L. This variation appear to be of great importance for the safeguard of melon germplasm and it could be used for future breeding programs.

Further studies will be carried out with a view to exploiting and collecting other Apulian and Albanian local genetic resources which will be evaluated and characterized also for other characters (bio-agronomic, biochemical and molecular), for the selection of genotypes resistant to

diseases, abiotic stresses and fruit characteristics. In addition, by means of the main molecular markers (RADP, AFLP and microsatellites), molecular analyses will be performed in order to estimate the genetic distances among genotypes. This information will be useful both to increase discrimination of sample during the conservation and to increase the value of superior genotypes also through the request of quality trademarks as envisaged by the U.E. regulations.

4. Conclusions

The work of identification and collection of Apulian and Albanian genetic resources have proved to be rather satisfactory as to the amount of genetic resources acquired and the number of species considered.

After the full acquisition of the genetic material, bioagronomic, biochemical and molecular evaluations will be started on the most interesting material to be included in breeding programmes, both for their direct use, should the selected genotypes give typical productions accepted by the markets, and for valuable economic repercussions in the regions under the "Interreg II" project.

The preliminary analysis of the variability of some bio-agronomic characters of *Cucumis melo* L. has already shown, in particular for the botanical variety "*inodorus*", the presence of some interesting genotypes submitted to self-fertilizations which may allow to set-up inbred lines useful for further studies.

Fig. 1 Broadbean landrace "Locale di Putignano"

Fig. 2 Broadbean landrace "Violetta Policoro"

Fig. 3 Some examples of the collected germplasm

Fig. 4 Some examples of "carosello"

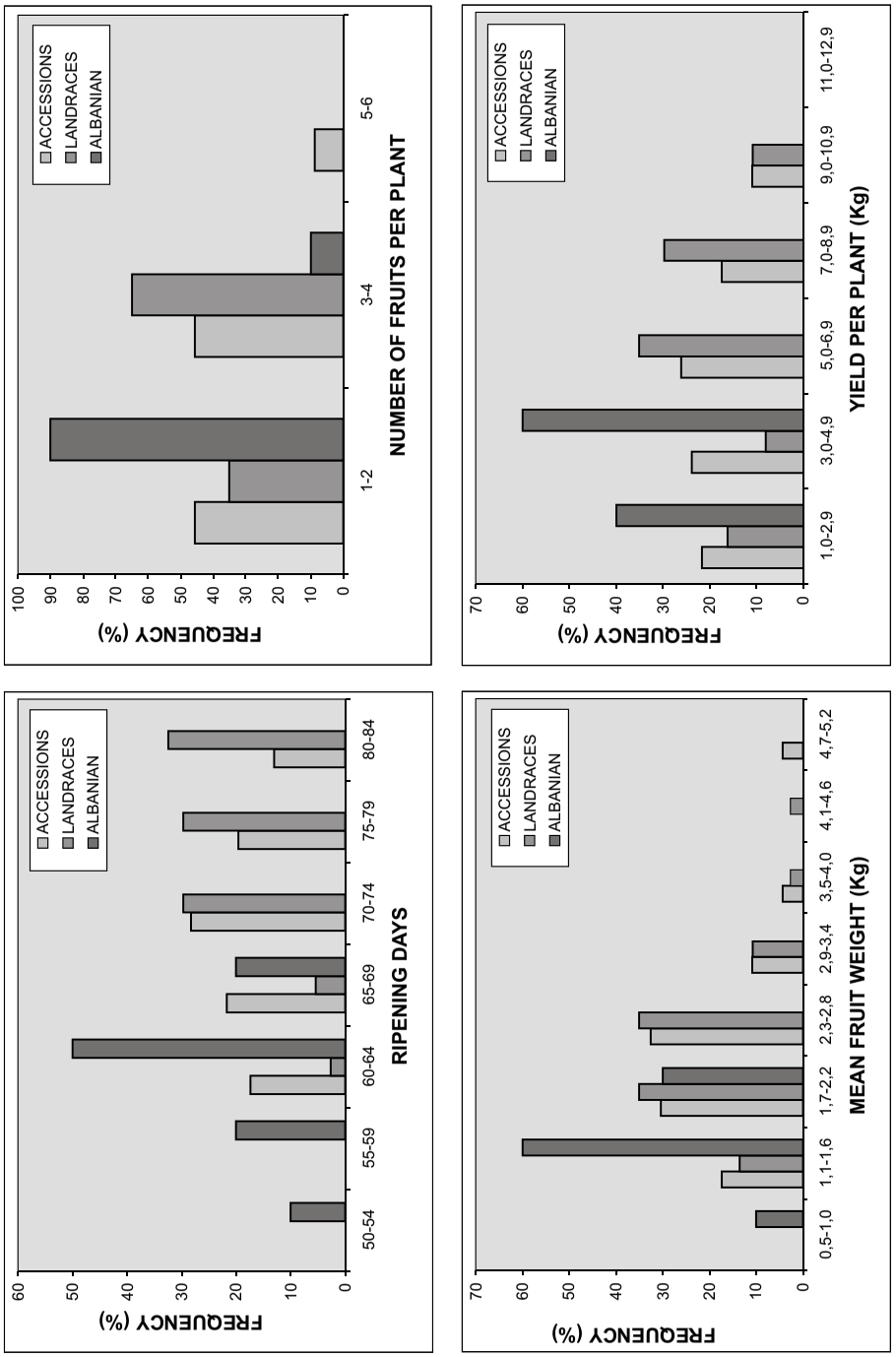

Fig. 5 Istograms of frequency estimated for earliness, number of fruits per plant, mean fruit weight and yield per plant on 93 genotypes of *Cucumis melo* L., belonging to botanical variety "inodorus".

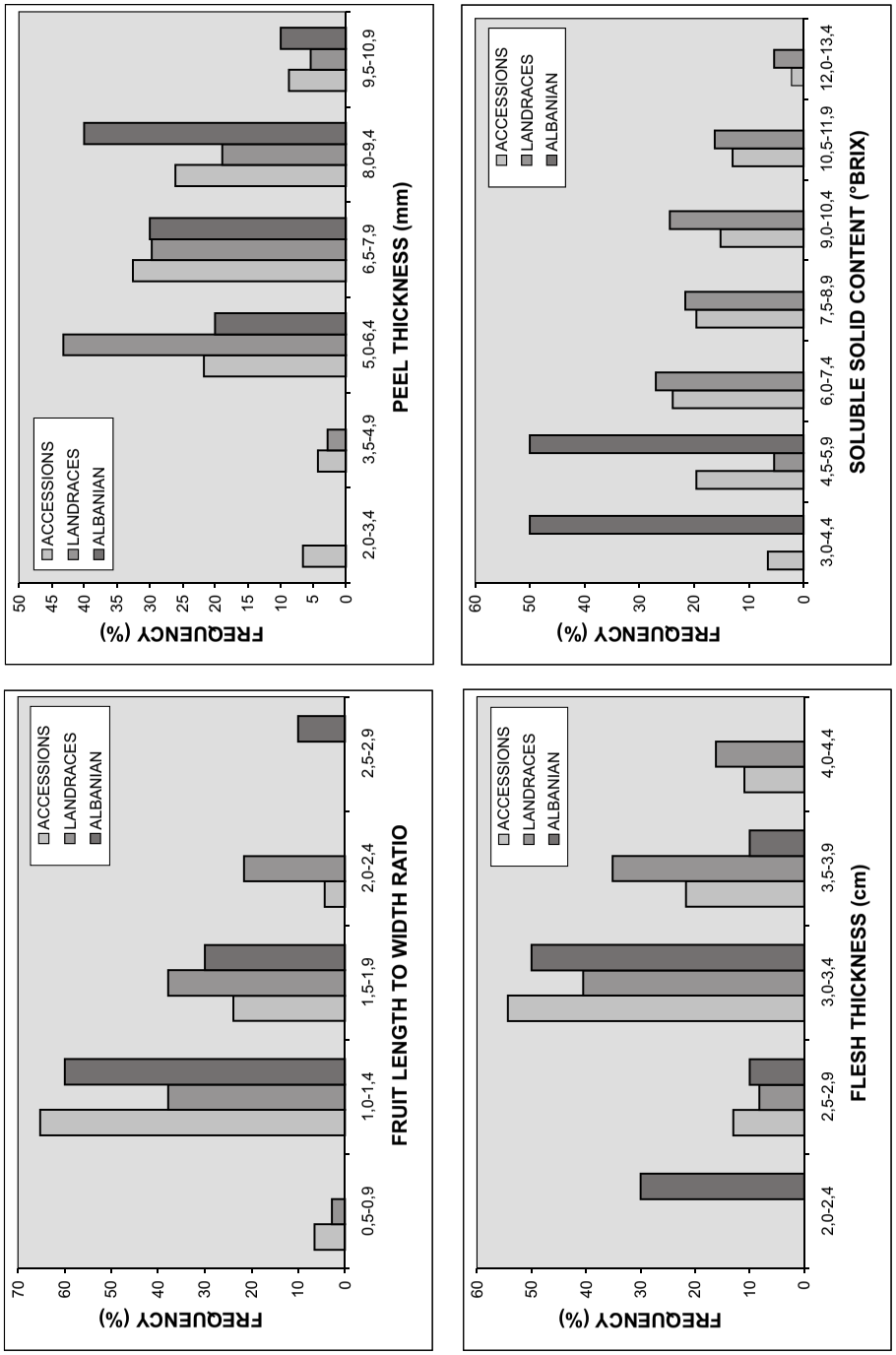

Fig. 6 Istograms of frequency estimated for fruit length to width ratio,peel and flesh thickness and soluble solid content on 93 genotypes of *Cucumis melo* L., belonging to botanical variety "inodorus".

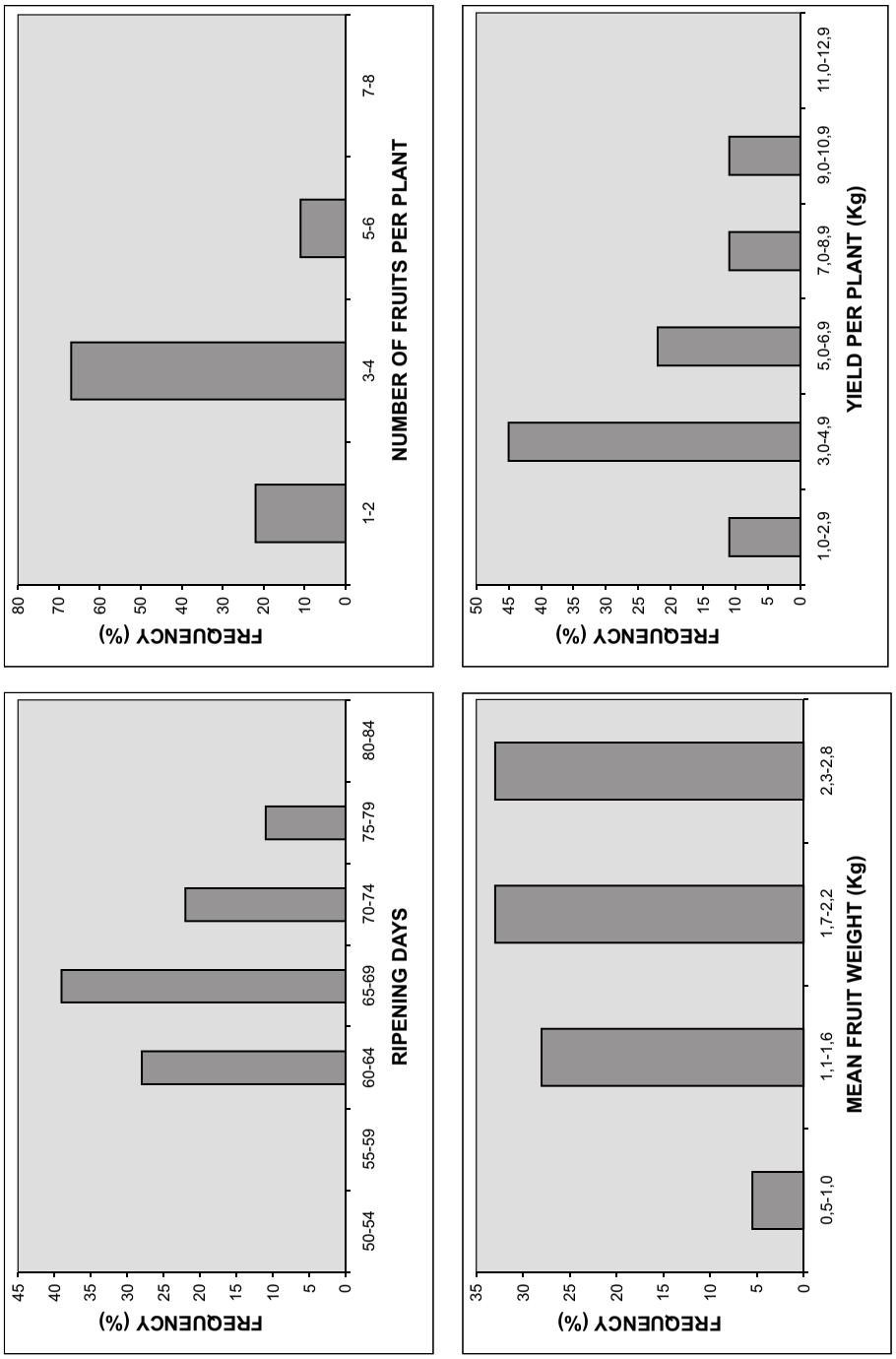

Fig. 7 Istograms of frequency estimated for earliness, number of fruits per plant, mean fruit weight and yield per plant on 18 genotypes of *Cucumis melo* L., belonging to botanical variety "reticulatus".

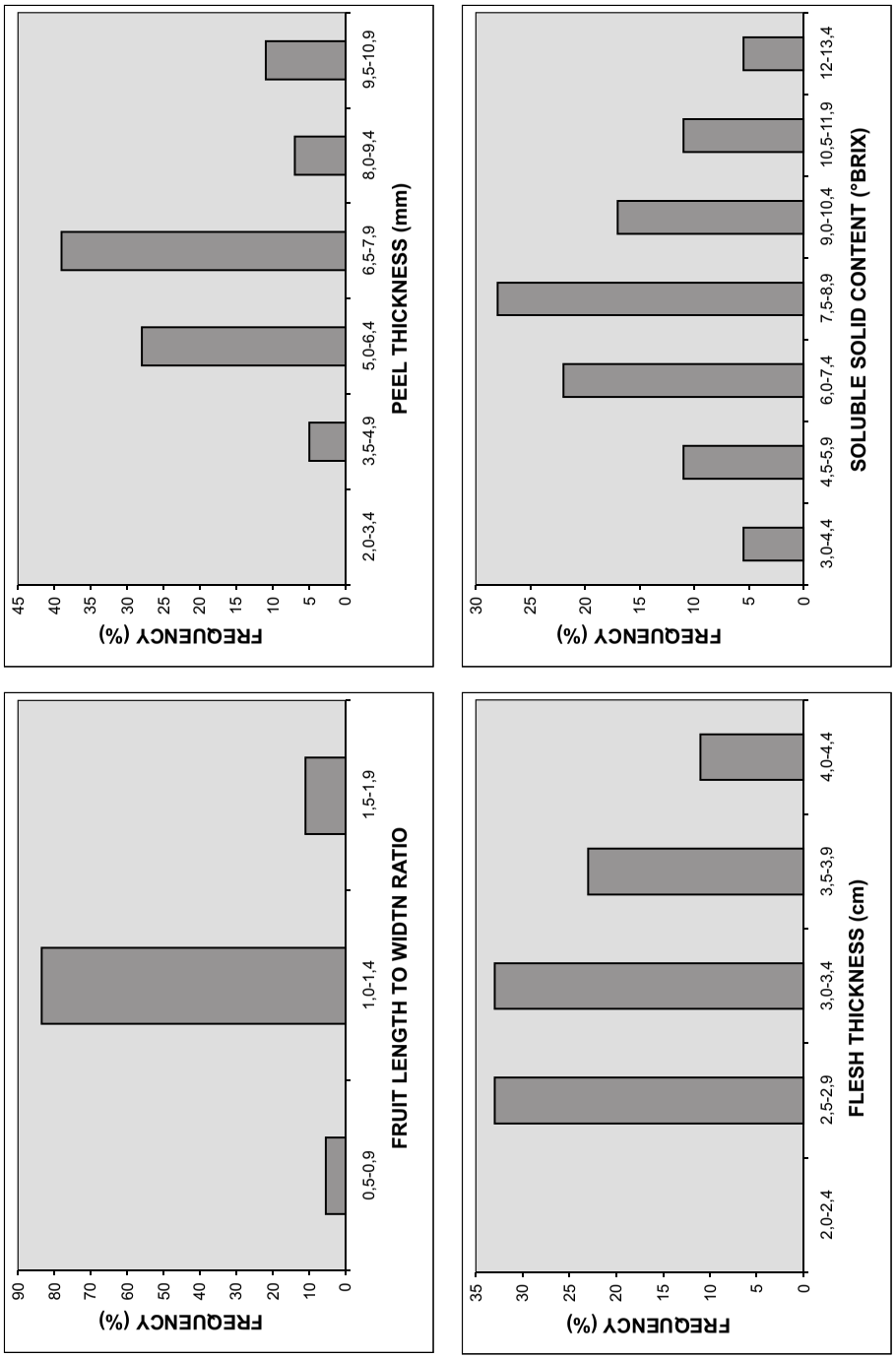

Fig. 8 Istograms of frequency estimated for fruit length to width ratio,peel and flesh thickness and soluble solid content on 18 genotypes of *Cucumis melo* L., belonging to botanical variety "reticulatus".

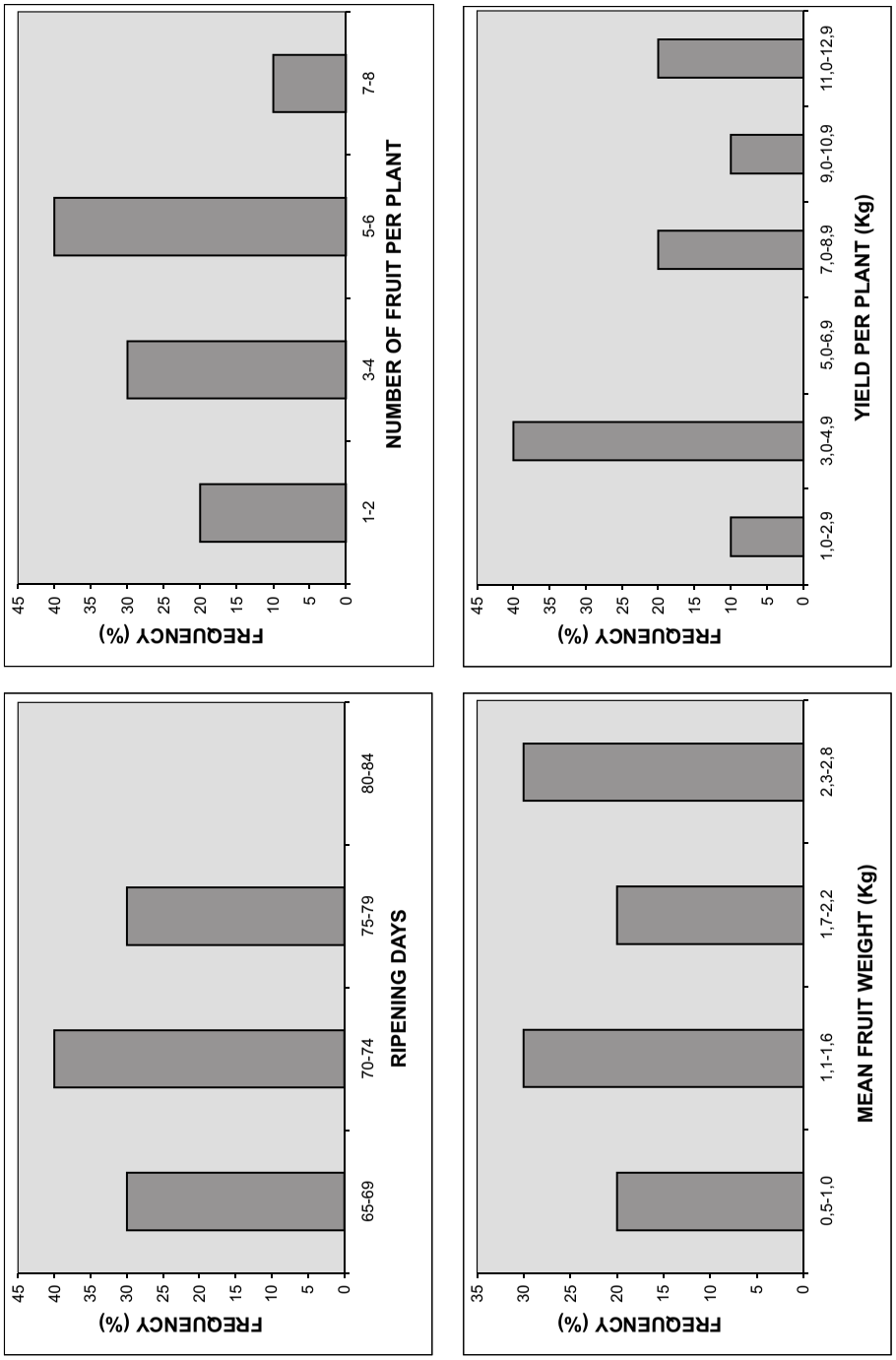

Fig. 9 Istograms of frequency estimated for earliness, number of fruits per plant, mean fruit weight and yield per plant on 10 genotypes of *Cucumis melo* L., belonging to botanical variety "cantalupensis".

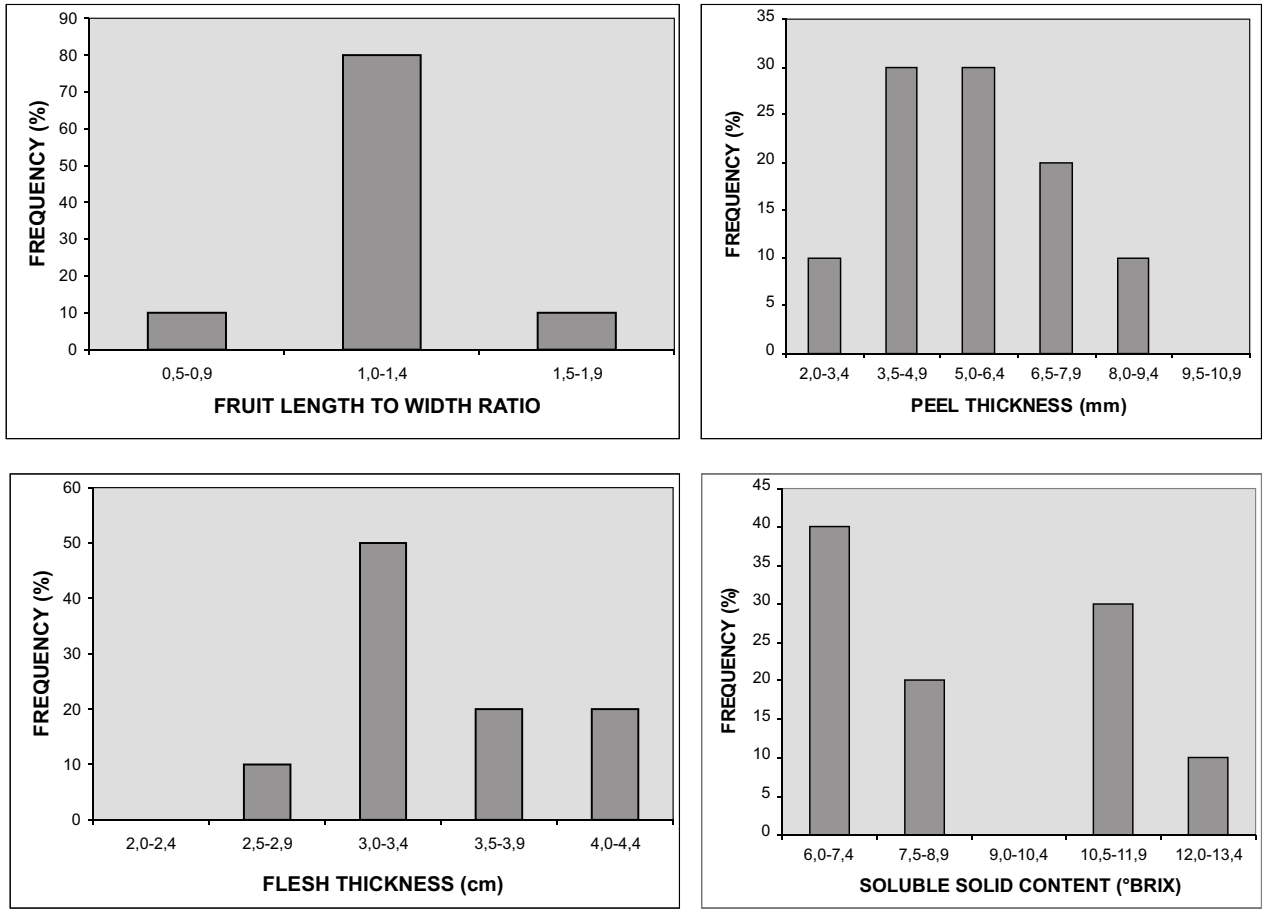

Fig. 10 Istograms of frequency estimated for fruit length to width ratio,peel and flesh thickness and soluble solid content on 10 genotypes of *Cucumis melo* L., belonging to botanical variety " cantalupensis ".

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