

Bulb morphological characteristics of garlic ecotypes from Istria

Bernard Prekalj^{1,2}, Mario Franić^{1,2}, Dean Ban^{1,2}, Iva Bažon^{1,2}, Danko Cvitan¹, Smiljana Goreta Ban^{1,2}

¹Institute for agriculture and tourism, Karla Huguesa 8, Poreč, Croatia

²Centre of excellence for biodiversity and molecular plant breeding, Zagreb, Croatia (smilja@iptpo.hr)



Introduction

Garlic (*Allium sativum* L.) is an indigenous species in Croatia and is mainly grown on small farms. Local ecotypes can be a source of genetic material. The aim of this research was to collect autochthonous ecotypes of red garlic in Istria and to describe them.

Methodological approach

Ten red garlic ecotypes were collected in Istria during the summer of 2018. Samples were taken from the following locations: Pićan (IPT341), Gračišće (IPT343), Lindar (IPT337), Beram (IPT345), Tinjan (IPT342), Rovinj (IPT340), Oprtalj (IPT346, IPT347, IPT348, IPT349). The analysis also includes the ecotype of Istrian Red Garlic (IPT013), which is listed on the Croatian conservation varieties list as preserved variety, and is held at the Institute for Agriculture and Tourism Poreč.

Samples were morphologically described by ECP/GR descriptors for *Allium* species (IPGRI, 2001). The following characteristics were described: shape of mature dry bulbs (7.1.11), shape of mature garlic bulb (7.1.12), outer skin colour of compound bulb (7.1.16.1.), skin colour of clove (7.1.16.2.), number of cloves per compound bulb (7.1.19.), bulb structure type (7.1.20.), shape of compound bulb in horizontal section (7.1.21.). Data are expressed as mean, mod and coefficient of variation.

Hierarchical cluster analysis was used to determine differences between garlic genotypes. Euclidean distance was used as the distance determination method, and Ward method used as a hierarchical algorithm. Cluster analysis was made in program environment R (R Core Team, 2008) using the *hclust* function from the basic program package.

Results

Eleven garlic samples were separated into two groups (Graph 1). Samples IPT346 and IPT348 are not taken into account in the analysis because they do not have a flower stalk.

IPT342 i IPT345 in first group have white-cream outer skin colour of compound bulb, white to yellow and light brown skin colour of clove and more numerous cloves per compound bulb (Table 1).

Second group is divided in two subgroups.

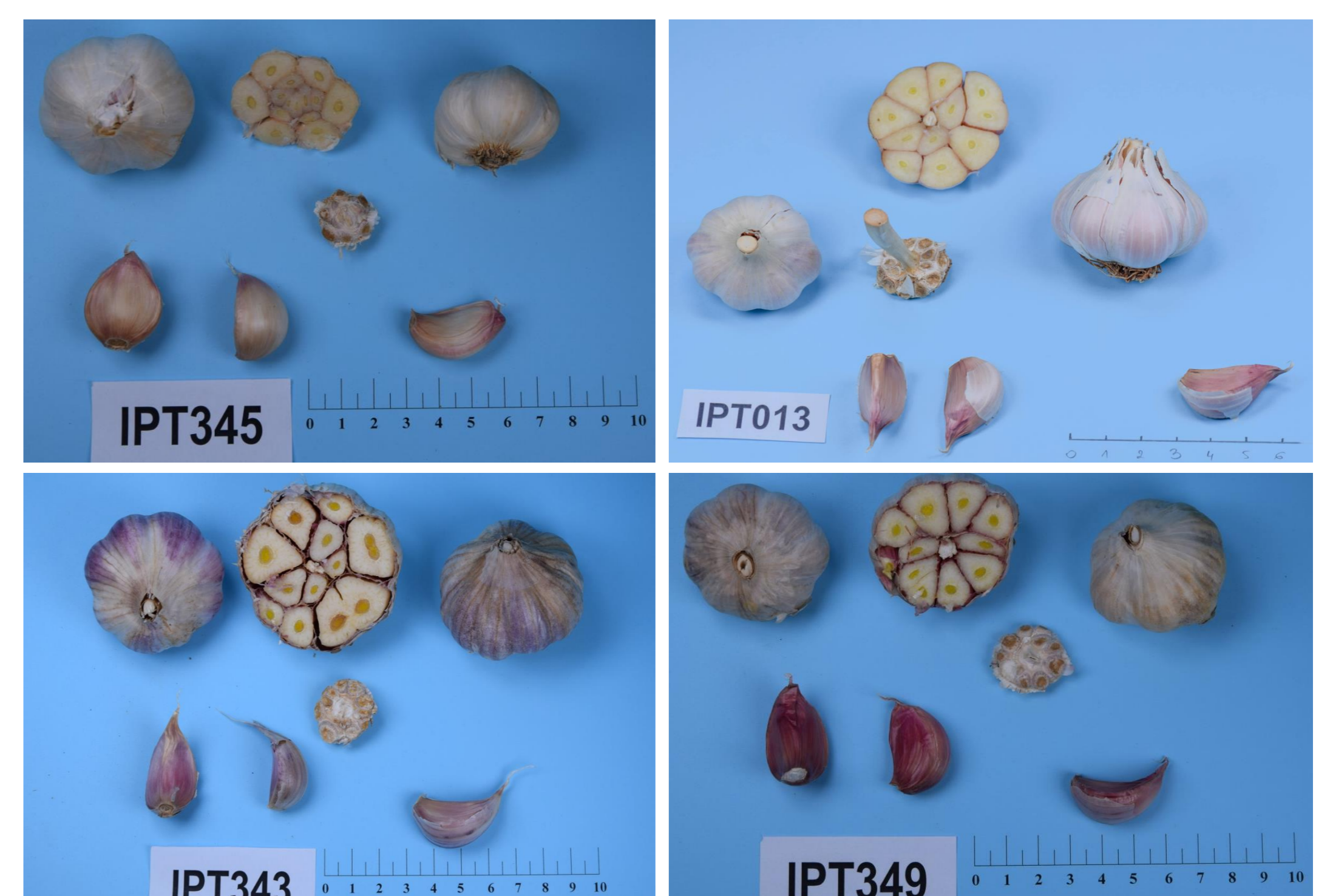
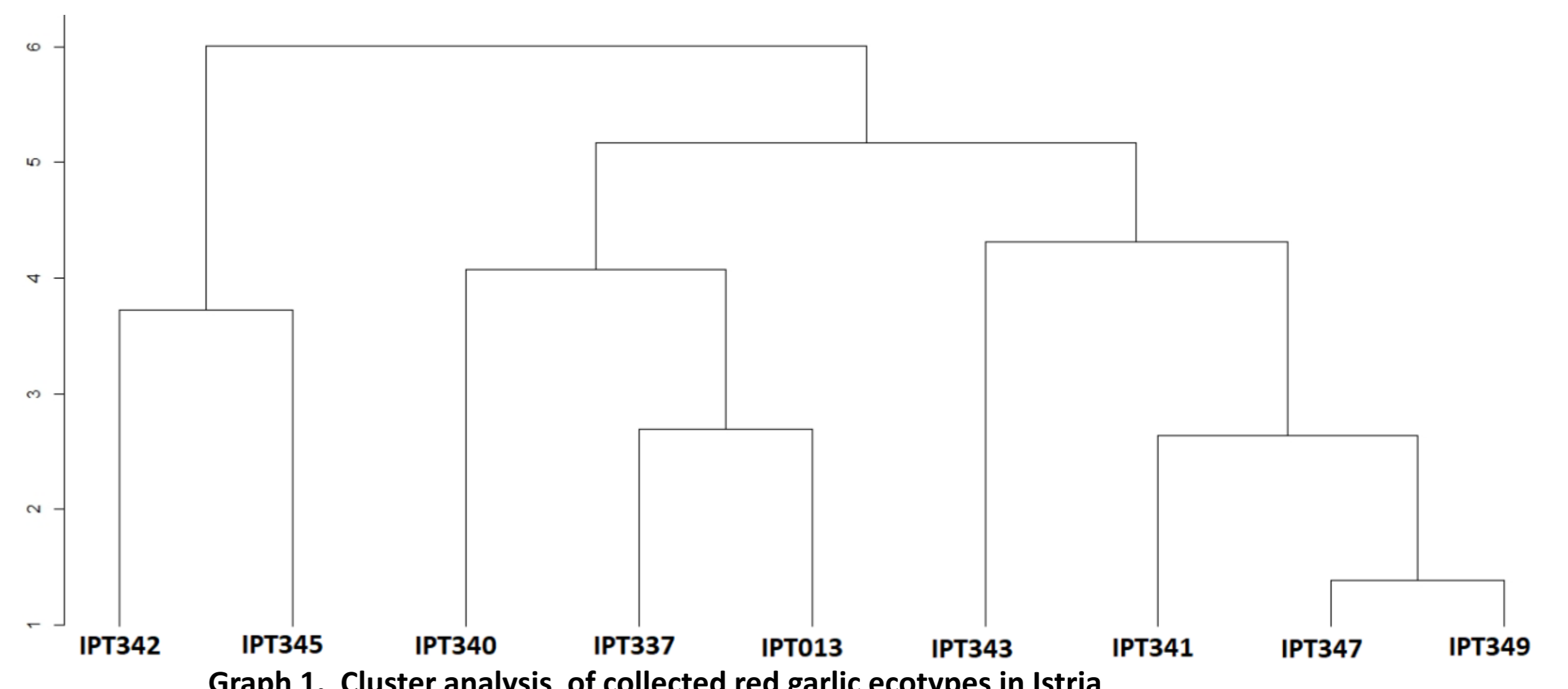
IPT340 and IPT337 from the first subgroup have violet skin colour of clove, regular two-fan groups type of bulb structure and shape of compound bulb in horizontal section is elliptic (Table 1). They are very similar with the sample IPT013 which is Istrian red garlic from the Croatian conservation varieties list (Picture 1).

Four samples are in the second subgroup. IPT347 and IPT349 have white-cream outer skin colour of compound bulb, violet skin colour of clove, medium number of cloves per compound bulb, regular two-fan groups bulb structure type, and circular shape of compound bulb in horizontal section (Table 1).

Table 1. Bulb characteristics of collected red garlic ecotypes collected in Istria

Code	Location		7.1.11. shape of mature dry bulbs ^a	7.1.12. shape of mature garlic bulb ^b	7.1.16.1. outer skin colour of compound bulb ^c	7.1.16.2. skin colour of clove ^d	7.1.19. number of cloves per compound bulb ^e	7.1.20. bulb structure type ^f	7.1.21. shape of compound bulb in horizontal section ^g
IPT013	Lindar	SV ^h	4	3	2	4	12,2	2	1,6
		M	4	3	2	4	12	2	2
		CV	0	0	0	0	13.27	0	32.27
IPT337	Lindar	SV	3	3	1,5	5	10,8	2	1,8
		M	3	3	1	5	11	2	2
		CV	0	0	47.14	0	13.73	0	24.84
IPT340	Rovinj	SV	2,1	3	5	5	15,8	2,4	2
		M	3	3	6	5	14	2	2
		CV	41.69	0	42.16	0	15.75	22.82	0
IPT341	Pićan	SV	2	3	5	5	9,4	3	1
		M	2	3	5	5	10	2	1
		CV	0	0	0	0	16.13	57.73	0
IPT342	Tinjan	SV	2,1	3	1,4	1,8	13,2	1,6	1,2
		M	2	3	1	1	15	2	1
		CV	35.13	0	36.88	93.69	16.42	34.23	37.26
IPT343	Gračišće	SV	2	3	6	5	14,2	1,4	1,2
		M	2	3	6	5	11	1	1
		CV	0	0	0	0	34.99	39.12	37.26
IPT345	Beram	SV	1,4	3	1,4	2,1	16,4	1,4	2
		M	1	3	1	1	15	1	2
		CV	49.94	0	36.88	75.95	18.08	39.12	0
IPT346	Oprtalj	SV	2,1	3	1,7	1,8	14,4	1	1,2
		M	2	3	2	2	16	1	1
		CV	27.03	0	28.41	23.42	12.61	0	37.26
IPT347	Oprtalj	SV	1,2	2,9	1,6	4,9	12,6	2,6	1,2
		M	1	3	1	5	11	2	1
		CV	35.13	10.90	98.60	6.45	33.95	74.97	37.26
IPT348	Oprtalj	SV	3	4	2	99	20,6	1	1
		M	3	4	2	99	22	1	1
		CV	0	0	0	0	13.55	0	0
IPT349	Oprtalj	SV	2	3	1	5	10,4	2,2	1
		M	2	3	1	5	12	2	1
		CV	0	0	0	0	22.13	20.32	0

^a 7.1.11. Shape of mature dry bulbs (1:flat, 2:flat globe, 3:rhomboid, 4:broad oval, 5:globe, 6:broad elliptic, 7:ovate, 8:spindle, 9:high top, 9:other), ^b 7.1.12. Shape of mature garlic bulb (1: circular, basal plate prominent, 2:heart-shaped, basal plate retracted, 3:broadly ovate, basal plate even), ^c 7.1.16.1. Outer skin colour of compound bulb (1:white, 2:cream, 3:beige, 4:white stripes, 5:light violet, 6:violet, 7:dark violet, 99:other), ^d 7.1.16.2. Skin colour of the clove (1:white, 2:yellow and light brown, 3:brown, 4:red, 5:violet, 99:other), ^e 7.1.19. Number of cloves per compound bulb (1:1, 2:2-4, 3:5-10, 4:11-15, 5:16-20, 6:>20, 7:around 50), ^f 7.1.20. Bulb structure type (1:regular multi-fan groups, 2:regular two-fan groups, 3: regular multi-cloved radial, 4:regular quadruple, 5:regular two-cloved, 6:irregular), ^g 7.1.21. Shape of compound bulb in horizontal section (1:circular, 2:elliptic, 99:other), ^h SV – mean, M – mod, CV – coefficient of variation (%)



Picture 1. Red garlic ecotypes collected in Istria

Conclusions

- The research has shown that samples grown geographically close have similar descriptive characteristics.
- It is assumed that agriculture producers use non certified planting material of the same or similar origin.
- Further genetic research will yield reliable data about the relationship of red garlic ecotypes in Istria.