A study of potential ability for cross-pollination in pea originating from different parts of the world

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Garden pea (*Pisum sativum* L.) is usually regarded as a self-pollinator. At the same time, occasional cross-pollination does occur when pea is bred outdoors. L. I. Govorov (1) reported that about 25% of the peas collected by N.I. Vavilov in Afghanistan segregated for some genes, suggesting a rather high cross-pollination rate in that country. According to our observations in Novosibirsk, plants grown in the field give several per cent seeds resulting from cross-pollination. The most frequent agents producing cross-pollination in pea are bumblebees, which visit open flowers. However, self-pollination is thought to occur before the flower opens. Thus, it is unclear how insects manage to bring about cross-pollination. It may be possible that some ovules remain unfertilized until after the flower opens.

The ability of pea samples to be cross-pollinated may depend both on genotype and environmental conditions. For this reason it was of interest to study, in the same environment, the amount of cross-pollination observed in peas from different locations. Two hundred eighteen accession from the All-Russian Plant Breeding Institute (St. Petersburg) were examined. The accessions studied were designated as coming from eight regions: 1) North Russia (Karelia, Komi, the Provinces of Arkhangelsk, Vologda, Pskov, Leningrad) (29 accessions); 2) the Dnieper basin (Ukraine, Belorussia, the provinces of Voronezh, Kursk, Smolensk, Kaluga, Rostov, Orel) (18 accessions); 3) the Caucasus (North Caucasus and Transcaucasia) (32 accessions); 4) Asia Minor (36 accessions); 5) the Balkans (Yugoslavia, Bulgaria, Albania, Greece) (28 accessions); 6) Ethiopia (31 accessions); 7) the Pamirs (Gorny Badakhshan) (21 accessions); 8) Afghanistan (23 accessions).

One plant of each accession was grown in a greenhouse in Novosibirsk. Immediately after a flower opened its keel was cut and pollen of a tester plant (line WL1238 line, homozygous for the tl^w allele) was applied to the stigma of the dissected flower directly on the stigma, which was already covered by pollen released from the anther sacs. Should cross-pollination occur, a plant heterozygous at the *Tl* locus (identified by the characteristic flat tendrils) should be produced. Three or four flowers of each plant were treated in such a way. The resulting seeds (3 to 30) were planted and the allelic composition at the *Tl* locus was determined one the basis of tendril shape. The results are presented in Table 1.

Table 1. Rate of cross-pollination in pea accessions from different regions of the world

Region	Number of accessions[1]		Percent of accessions with cross-pollination	Number of seeds produced by plants[2] where cross-pollination occurred		Number of seeds produced by plants[2] where no cross-pollination occurred
	with cross-pollination	no cross-pollination		cross-pollinated	self-pollinated	
Afghanistan	1	22	4.35	2	12	262
Caucasus	2	30	6.25	2	11	369
Balkans	2	26	7.14	10	22	293
Asia Minor	3	33	8.33	10	26	357
Ethiopia	3	28	9.68	5	40	375
Dnieper Basin	2	16	11.11	2	6	196
North Russia	6	23	20.69	7	73	303
Pamirs	6	15	28.57	8	54	203
Total	25	193	–	46	244	2358

[1] Each accession was represented by one plant
[2] Only seeds produced by treated flowers were collected

One can observe a wide range of cross-pollination frequency in regional samples (Fig. 1). The highest frequency was found in two regions: North Russia and the Pamirs. Mean percentage of accessions showing cross-pollination in a combined sample for these two regions is 24.0 ± 4.3%, compared to 8.3 ± 1.5% in the remainder. No other geographic regularities in the observed frequency of cross-pollination were observed.

Thus, we have shown that at the moment of the flower opening some peas have ovules still available to be pollinated. It should be noted that environmental conditions of the Pamirs are in some respect similar to those of the North Russia. Both regions are situated on the climatic border of agriculture and characterized by cool temperatures during the growing season and a relatively low density of insect pollinators. Thus, accessions originating from Gornyi Badakhshan and North Russia can be used as a source of germplasm intensifying the rate of cross-pollination.

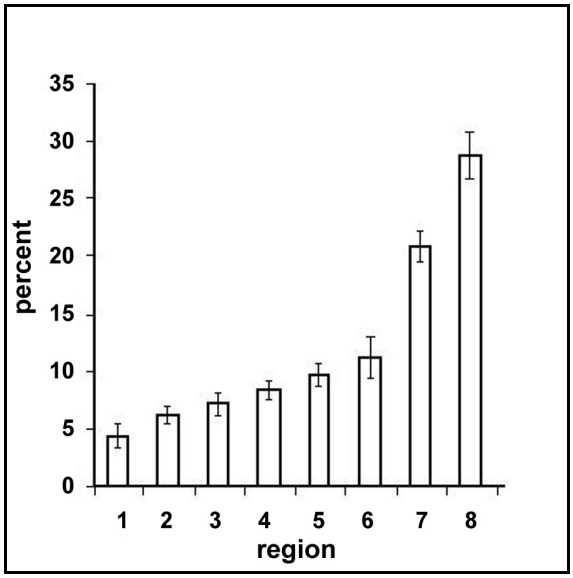

Fig. 1. Percentage of accessions (mean value ± standard error) where cross-pollination was observed. 1 – Afghanistan; 2 – Caucasus; 3 – Asia Minor; 4 – Ethiopia; 5 – Balkans; 6 – Dnieper basin; 7 – North Russia; 8 – Pamirs.

1. Govorov, L. I. 1928. Gorokh Afganistana (K probleme proiskhozhdeniya kul'turnogo gorokha) [Pea of Afghanistan (To the Problem of Origin of Cultivated Peas)] In: Trudy po prikladnoi botanike, genetike i selektsii. 19: 497-522.