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To the ongoing ”shaping” of domestic legume and pumpkin germplasms

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Abstract

The present study is focused on the abundance of Kazakhstan food as heirloom legume and pumpkins varieties and lines based on the developing seed bank comprised of domestic as foreign accessions and varieties received from EU countries, Russia, USA and Asia. Certain introduced common bean varieties have demonstrated high seed germination, maturation rates and dehydration tolerance, whereas domestic varieties have been indicated to outstrip other domestic varieties, lines as external accessions and varieties by seed weight and other seed parameters.

Key words: common bean, pumpkin, germplasm, variety, productivity, seed parameters

Introduction

Legumes and pumpkins, when harvested under harsh continental conditions of Kazakhstan, may exhibit essentially high variation of plant and seed parameters, growing periods and harvest structure. Such a great variability completed by increased cross-pollinating ability under conditions of drought, high temperature and the vicinity of blossoming gardens in the mountain zone of Almaty Region may be used for the development of new varieties, especially taking into account substantial water deficit which Kazakhstan and neighbouring Central Asian states (except Kyrgizstan) are facing at present. So, natural stress imposed by instant temperature fluctuations, extreme sun irradiation, lack of water and drastic diurnal, nocturnal and seasonal changes lead usually to visible phenotypic alterations, if compared with those less traceable in the conditions of moderate climate. Data with this respect have been summarized earlier (Gutsalyuk, 1989; Burgmans, 1994; Taranov et al., 2005; Aytasheva et al., 2006; Aytasheva et al., 2009).

A number of characteristic common bean (*Phaseolus vulgaris* L.) and azuki bean varieties [*Vigna angularis var. angularis* (Willd.) Ohwi & Ohashi] have been studied under local, continental conditions of the high-mountain zone. Germplasm samples have included domestic, ‘high-protein seed” varieties, and various accessions granted by the Japanese Genetic Bank, a N.I. Vavilov Research Institute of Plant Industry, Russia, and other seed resources located in France, Italy, People’s Republic of China, Poland, UK and USA. Some of trialed bean varieties and related species have revealed conspicuous diversity in seed maturation and germination rates, productivity and drought tolerance. As it has been shown, new Kazakhstan varieties would outstrip a number of annotated external accessions and varieties by seed protein concentration and other remarkable characters. The aim of current article is examining of domestic and foreign bean and pumpkin varieties for their productivity and adaptation under harsh continental conditions of the mountain zone of Almaty Region to use optimal parental combinations for subsequent breeding activities.

Material and methods

A range of foreign varieties (‘Bijchanka’, ‘Bomba’, ‘Camelia’, ‘Cornell’, ‘Dove’, ‘Igolinska’, ‘Laura’, ‘Malinka’, ‘Nicos’, ‘Pinto’, ‘Otrel’, ‘Red Goya’, ‘Sadovod’, ‘Scarlet Emperor’, ‘Supernano’, ‘Ufimskaya’, and ‘Vegetable Sack’es’) have been sown on 3x5 m plots in the mountain area of Almaty Region. Different varieties of food as heirloom pumpkins (‘Coloquinte en Melange’, ‘Huannanguan’, ‘Mantnaya’, ‘Vitaminnaya’, ‘Volzhskaya Seraya’, ‘Zucchetto ornamentale’ and etc.) have been sown on organically fertilized soil for seed propagation

and resistance tests under the mountain conditions of Amaty region in 2009-2011.

Foreign common bean varieties have been studied for the period of seed ripeness, seed productivity and other characters together with three domestic varieties 'Aktatti', 'Dzhungarskaya', and 'Nazym" obtained autochthonously. Quantitative traits of these three common bean varieties have been assessed by measuring 100-, 200-, 300-, and 1000-seed weights along with determination of the seed length and width. Statistical significance for pod formation, seed weight, length and width was determined by using standard EXCELL programmes and by Vasil'eva (2007).

Results and discussion

In 2008-2011 totally more than 80 bean varieties originating from different countries (e.g. cvs 'Nicos' (Bulgaria), 'Igolinska', 'Bomba', 'Otrel' and 'Malinka' (Poland), 'Ufimskaya', 'Bijchanka', 'Cornell', 'Laura', 'Vegetable Sack'es', 'Supernano' and 'Sadovod' (Russia), 'Dove' and 'Scarlet Emperor' (UK), 'Pinto', 'Red Goya' and 'Camelia' (USA) have been introduced to the mountain area of Almaty Region and partly granted to the Institute of Potato and Vegetable Plants Research (JSC KazAgroInnovation). These varieties have shown a proper seed ripeness despite a severe affect of the late drought. Eight azuki bean varieties completed by few broad bean varieties (*Vicia faba* L.) as lentil (*Lens culinaris* L.), have been trialed under similar conditions of the mountain zone. Interestingly, comparison of the Russian and the Japanese azuki bean resources has allowed to indicate the best accessions with highest yields under these conditions. Despite relatively moderate germination rates, some of these varieties have confirmed their high thermo stability and drought tolerance.

Comparing to common bean, azuki bean, while being cropped in the mountain zone, has been characterized by delayed leaf vegetation and belated onset of the flowering and pod formation. This has caused the "wavy", or repeated anthesis in hot and dry conditions.

Fabaceous collection established may be used for extensive student training. In turn, young explorers assist in estimations of seed qualitative and quantitative traits (Table 1). As seen from the table, cv. 'Nazym' is leading in its productivity since it has indicated the largest seed weight while harvested both on Northern and Southern plots.

As demonstrated by subsequent experiments (data not shown), cv. Nazym collected both from Northern, and Southern plots does surpass by certain seed parameters (namely, seed length, width, and 100-, 200-, or 300-seed weights) other domestic varieties. Moreover, in 2011 this variety harvested from open and drastic Northern plot has manifested the yield which occurred almost 7 times greater (1065 seeds) comparing to that one obtained from the same cv. 'Nazym' harvested on a more mild and shady Southern plot (165 seeds, including those 15 motley). At the same time both populations have indicated no statistically significant differences in the rate of pod formation. For example, the reliability criterion (t_d) occurred 7-13 times lower (0.30) than that one characteristic for reliable differences indicated at different probability levels (t_d 2.11, t_d 2.90 and t_d 3.97 at P 0.95, P 0.99 and P 0.999, respectively). This fact may emphasize that cv. 'Nazym', revealing no differences in pod formation under different conditions of the small-scale cropping, is completely adapted to increased temperatures, severe dehydration and sharp insolation.

Table 1. Productivity of domestic common bean varieties in 2010

Character	Bean varieties			
	Dzhungar-skaya	Aktatti	Nazym (Northern Plot)	Nazym (Southern Plot)
Seed length	2.56±0.07	2.53±0.08	2.68±0.08	2.70±0.08
Seed width	0.77±0.06	0.80±0.06	0.85±0.07	0.86±0.06
100-seed weight	50.03±0.22	55.31±0.77	73.49±1.29***	78.19±1.85***
200-seed weight	100.26±0.68	111.15±1.66	146.10±0.40***	156.27±2.39***
300-seed weight	148.87±1.49	167.02±0.44	219.6±1.70***	225.8±0.96***
1000-seed weight	496.23±4.97	556.73±5.83	732.00±6.00***	752.67±3.00***

*** P>0.999

Biodiversity and breeding research on food and heirloom pumpkins *(Cucurbita pepo* L.) has been initiated at our department in 2009. This diversity of vegetable plant species may be used for delicious meal courses typical of the Central Asian region as a whole, roasted seeds, natural recovery of patients with stomach and

liver problems, glowing jack-o'-lanterns and effective soil amelioration. Present collection includes domestic, Russian, Chinese, French and Italian species. Collection of French pumpkins (Fig. 1) by harvesting in the year 2010 has been shown to differentiate substantially by the seed resistance to fungi (data not shown).

Figure 1.
French cultivars of heirloom pumpkin ('Coloquinte en Melange') cropped on enriched soil under mountain zone of Almaty region in 2010. (The set of pumpkins, upon a 2010 harvesting has been demonstrated to strongly vary by the seed tolerance to fungi).

Referring to numerous reports on nutritional value of the heirloom pumpkin as potential green-house product, especially in the winter period, we may need to revise our present attitude to this miniature pumpkin in our further theoretical and applied breeding programs to come true.

Balkan Peninsula is attributed to one of traditional centers for the vegetable plants cropping and related research. Realizing the role of Kazakhstan as one of quickly developing countries open for crop diversification in front of ongoing and strengthening global food crisis, researchers in this country are ready for more extensive, bilateral as multilateral collaborations in all the directions highlighted in this communication.

Conclusions

The series of new common bean varieties have been generated under mountain zone of Almaty Region. Some of them such as cv. 'Nazym' have revealed virtually no differences in pod formation under small-scale cropping at different plots completely fitting to growing temperatures, water deficit as the sun beam. In addition to this, since 2009 the biodiversity and breeding research on food and heirloom pumpkins, *Cucurbita pepo* L. has been undertaken towards enriching domestic, Chinese, French, Italian and Russian germplasms in hand. These efforts would result in eventual diversification of agriculture in the South of Kazakhstan especially taking into account a growing pressure of ongoing world food crisis, current trends in the world crop and common bean market, and obvious need in widening cooperation with this respect.

Despite modest germination speed, some of the common bean varieties and closely related species have revealed high dehydration resistance. Cv. 'Nazym' has been shown to surpass by seed weight, length and width resting domestic varieties.

Balkan countries as conventional network renowned for vegetable plants cropping, breeding and research are in the focus of related field of research in Kazakhstan aimed at more extensive crop diversification under continuing global food crisis in order to develop wider cooperation around bean biology and other vegetable plant studies hereafter.

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