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Cultivated emmer is valuable germplasm for durum wheat breeding

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SUMMARY – Study of intraspecific diversity of emmer [*Triticum dicoccum* (Schrank) Schuebl] in Ukraine conditions revealed samples which may be sources of economic-valuable characters for durum wheat breeding: resistance to common bunt, dusty smut, leaf rust, powdery mildew, septoria disease; early ripeness; productive tillering, spikelet number per ear; ecological stability of yield capacity; protein content in grain. In emmer-durum hybrids, high macaroni qualities may develop. Emmer could be grown as groat crop, of which one may prepare kasha of high quality. It may be used as dietary dish.

Key words: Emmer, breeding, interspecific hybridization, immunity, quality, ecological stability.

RESUME – *"L'amidonnier est un germoplasme de grande valeur pour l'amélioration du blé dur". L'étude de la diversité intraspécifique de l'amidonnier [*Triticum dicoccum *(Schrank) Schuebl.] dans les conditions de l'Ukraine a permis de révéler les échantillons qui peuvent être des sources de caractères économiquement utiles pour la sélection du blé dur : la résistance face à la carie naine, le charbon nu, la rouille brune, l'oidium, la septoriose ; précocité, tallage productif, le nombre d'épillets dans l'épi, la stabilité écologique de la fertilité ; le contenu en protéine dans le blé. Avec les hybrides amidonnier-durum on peut atteindre de hautes qualités pour les macaronis. L'amidonnier peut être cultivé comme culture pour gruau, à partir duquel on peut préparer du kasha de haute qualité. Il peut être utilisé comme plat diététique.*

Mots-clés : *Amidonnier, amélioration, hybridation interspécifique, immunité, qualité, stabilité écologique.*

Introduction

Emmer, *Triticum dicoccum* (Schrank) Schuebl., the ancient hulled 28-chromosome wheat species, was used successfully in breeding of a number of durum wheat cultivars widely spread over the territory of former USSR. In particular, in the Ukrainian Institute of Plant Production, Breeding and Genetics named after V.Ja. Yurjev, breeder P.V. Kuchumov had created the best cultivar for that time (Kharkovskaya 46) from the cross *T. turgidum / T. dicoccum // T. durum* (Golik, 1996). Intraspecific diversity of cultivated emmer gives possibility for more its more effective use. But it is necessary to study the better economic and biological traits of various emmer forms and types.

Materials and methods

We carried out a study of 159 samples from a collection of the Vavilov Institute of Plant Industry (VIR, Sankt-Peterburg) in the years 1993-1999 under east Ukraine (Kharkov) conditions. It is a temperate climate zone. The mean of many years temperature ranges from 7.6ºC at sowing period (1-st decade of April) to 21.9ºC at ripening (1-st decade of August); the precipitation sum for the vegetation period of emmer is 252.7 mm. Daylight is long: up to 20 hours in 3-rd decade of July. Years of studying differed greatly in temperature and humidity conditions: 1993, 1994 were near to much-year norma and favorable for growth and development of emmer plants; 1995,1996,1998,1999 years were very-drought-afflicted; 1997 was extremely damp.

The collection of emmer was being sown in experimental field after pea as forecrop. Plot size was 2 m^2 in 1993-1997 and 1 m^2 in 1998, 1999 years. Durum wheat cultivar Kharkovskaya 37 was being used as standard for emmer samples.

Results and discussion

As a result of study, a number of samples were revealed carrying economic-valuable characters; these samples are able to serve as sources for durum wheat breeding.

Most early-ripe are samples (here and further numbers of VIR catalogue are shown): 15840 (Morocco), 19564 (Ethiopia), i-545052 (India), 20967 (Turkey), 31602 (Azerbaijan, Nakhichevan), 24482 (Russia, Chuvashia).

Value of emmer as resistant source of immunity to fungus diseases is confirmed. The samples: 859 (Russia, Orenburg region), 20579 (Spain) are resistant to the Kharkov population of common bunt, powdery mildew, leaf rust, septoria disease; resistance to three diseases – powdery mildew, septoria diseases, leaf rust – was shown by entries 15007 (Poland), 38185 (Latvia), 9934 (Russia, Leningrad region), 19360, 19362 (Ukraine, L`viv region), i-528519A (Switzerland), 18774 (Belarus`), 7494 (Russia, Bashkortostan), 14067 (Armenia). The samples PPGG-7 (33226, Russia, Ul`yanovsk region) are resistant to dusty smut, common bunt, powdery mildew. Resistance to dusty smut, powdery mildew, septoria disease showed: 10456 (Russia, Tatarstan), 30091 (Azerbaijan), 7529 (Russia, Uljanovsk region).

It is doubtful whether emmer could be a source of lodging hardiness. However, some samples of subspecies *dicoccum* (european*)* and subspecies *asiaticum,* although have enough high stem (120-150 cm), are comparatively little inclined to lodging: 19352, 19358 (Ukraine, L`viv region), 15007 (Poland), 36527 (Sweden), i-528519A (Switzerland), 21588 (France), 38185 (Latvia), 18774 (Belarus), 81, 7504, 7505 (Germany), 22481 (Russia, Chuvashia), 13883 (Armenia), 33226 (Russia, Ul`janovsk region), Daghestanian local emmer.

One of the most important properties for the sake of which emmer is being included in programs of durum wheat breeding, is ecological stability of yield capacity. We had estimated the index of the stability according to the method of Eberhard and Russel (1966). It should be said that yield of emmer, even of better samples, was lower than of durum standard Kharkovskaya 37. It stands to reason, because emmer cannot compete with one of the best durum cultivars created as a result of intensive breeding work. Yield capacity of the best emmer samples was to 350 g/m^2 whereas those of standard to 530 g/m^2.

The stable high yield capacity in contrasting years of our experiments showed the samples of subspecies *dicoccum* 81 (Germany), i-528519A (Switzerland), 36527 (Sweden), 19358 (Ukraine, L`viv region), 21588 (France); subspecies *asiaticum* 33226 (Russia, Ul`janovsk region), 47795 (Russia, Leningrad region), 23036 (Yugoslavia). Ecological stability at as high as mean level of productivity show the samples of subspecies *dicoccum* 19352,19358 (Ukraine, L`viv region); subspecies *asiaticum* 14043 (Armenia), PPG 7 33226 (Russia, Ul`janovsk region), Daghestanian local emmer, 13011, 22481 (Russia, Chuvashia), 6436 (Georgia); subspecies *aethiopicum* 13895 (Ethiopia).

High responsiveness to growing conditions, in combination with high productivity, is a characteristic feature of the samples i-528519A (Switzerland), 10456 (Russia, Tatarstan), 136614, 23640 (Armenia). Relatively high productivity of named samples is connected with stable heightened level of structural elements: 15007 (Poland) – productive tillering (p.t.), spikelet number per ear (s.n.) and grain weight per ear (g.w.); i-528519A (Switzerland) – p.t., s.n., grain number per ear (g.n.), weight of 1000 grains (w.1000); 21588 (France) – p.t., s.n., g.n.; 36527 (Sweden) – p.t., g.n., PPG 7 (33226, Russia, Ul`janovsk region) – p.t., s.n.; 81 (Germany) – s.n., g.n.; 19352, 19358 (Ukraine, L`viv region) – s.n.

At the same time, at the samples 47795 (Russia, Leningrad region), 23036 (Jugoslavia), 14043, 23640 (Armenia), 6436 (Georgia), 13011, 22481 (Russia, Chuvashia), 13895 (Ethiopia), all mentioned elements have a medium level of display, but a favourable combination. It should be emphasized that ear productivity at emmer is strongly determined by grain number of spikelet, which is limited by 2 pieces.

In common, the majority of emmer samples, even named above high-productive, show protein content in grain from 17.5 to 21%, exceeding standard of durum wheat Kharkovskaya 37 by 1.5-5%, at good filling of grains. This trait is being inherited well by hybrids of emmer with durum wheat. In our earlier experiments (Sergeeva *et al.,* 1988), white-grained forms in later generations of such hybrids (F_6-F_7) had macaroni quality of grains estimated as “maximum high”: grain color is amber; at macaroni color is yellow, boil capacity to 4.3 time, strength from 800 to 973 g. Majority of emmer forms have red grains. This sign is dominant, but determined by a few genes, therefore it is relatively easily to select white-grained forms already in early hybrid generations.

The negative feature is hullness of emmer, which may be overcome by backcrossing of emmer-durum hybrids by durum recurrent parent.

It is well known that grain of emmer has high groat qualities. Trials carried out by Filatenko *et al.* (1983) were confirmed by our own experiments: the small groat boils quickly; boiled kasha is friable, has a very apealing smell and taste, is easy and favorable for eating. It may be used as dietary dish.

Conclusions

Hence, wide study and use of genetic diversity of emmer is promising to enhance breeding improvement of durum wheat. Emmer could be used also as such, as groat crop-source of high quality dietary dish.

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