E-optimal block design with nested rows and columns for research on alternative methods of limiting slug damage

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Slugs (Gastropoda: Pulmonata: Stylommatophora) are polyphagous and feed on both animal and plant material. There are numerous species occurring throughout Europe and some are considered serious pests of arable crops (Moens & Glen, 2002). In Poland three slug species are recognized as notable pests, *Deroceras reticulatum* (O.F. Müller, 1774), appearing commonly, and *Arion lusitanicus* Mabille, 1868 and *Arion rufus* (Linnaeus, 1758) in only some areas (Kozłowski & Kozłowska, 2002). These species cause damage to vegetables, arable crops, orchards, and ornamental and herb plants. Besides these plants, the slugs graze on numerous weed species, wild growing herbs and animal material. That capability to feed on different food allows them to survive in agricultural environments during periods when arable crops are not available.

Application of molluscicidal bait pellets is, along with agricultural measures, the most popular slug control. The efficacy of these products is however often unsatisfactory. Moreover, molluscicidal bait pellets can cause a threat to fauna, such as useful invertebrates and some vertebrates. Thus a search for alternative control means for decreasing slug populations in arable crops successfully has become an important part of research projects. The research on alternative methods of limiting slug damage was carried out in block designs with nested rows and columns

In this paper we extend the theory of block designs with nested rows and columns. We consider optimality of the designs possessing special property with respect to any criterion of a described form. Bogacka (1991), Das and Kageyama (1991) and Kozłowska (1990, 1999) considered a class of E-optimal designs (strictly specking, E_R-optimality). Hence we consider E- and E_R - optimality of block designs with nested rows and columns applied to special plant protection experiment mentioned above.

Reference

Bogacka B. 1991: On statistical properties of A_R, D_R and E_R -optimal block designs. *XXI Methodological Colloquia on Agrobiometry*, 126-138.

Das A., Kageyama S., 1991: A class of E-optimal proper efficiency-balanced designs. *Biometrika* 78, 693-696.

Kozłowska M., 1990: E_R - optimal block designs. *XX Methodological Colloquia on Agrobiometry*, 117-124.

Kozłowska M., 1999: Optimality of some class of incomplete block designs. Biometrical Journal 41, 4: 427-430.

Kozłowski J., Kozłowska M. 2002: Assessment of plant damages and intensity of *Deroceras reticulatum* (Müller) occurrence in winter oilseed rape and winter wheat. *J Plant Protection Res* 42(3):229-237.

Moens R., Glen D.M. 2002: Agriolimacidae, Arionidae and Milacidae as pests in west European oilseed rape, *in Molluscs as crop pests,* ed by Barker GM, CABI Publishing, Wallingford UK, 425-439.