Foreword

Legumes in sustainable agriculture

Sergio G. Atienza and Diego Rubiales

Institute for Sustainable Agriculture, CSIC, Alameda del Obispo s/n, 14004, Córdoba, Spain.
Emails: sgatienza@ias.csic.es; diego.rubiales@ias.csic.es

Agriculture faces unprecedented demands for food and feed production due to the increase in world population predicted for the next decades. The growing concerns on environmental and food security make necessary to face these demands with more sustainable and environmentally friendly agricultural practices which constitute a high challenge for researchers and farmers all over the world.

Under this pressing scenario, legume crops must play an important role due to their widely acknowledged beneficial roles. The nitrogen-fixing properties of legume crops have a positive impact on environment since they increase soil fertility and reduce the requirements of inorganic fertilizers. The utilization of legumes in crop rotations also allow for the mitigation of pest and diseases in subsequent crops, which help in reducing farmer costs and protecting the environment. Despite the advantages of legumes, their cultivation has not achieved the expected results and the cultivation area devoted to some legumes has declined worldwide in the last 50 years.

This special issue was conceived as an opportunity to focus attention on the role of legumes as part of sustainable food production. The timing is important since 2016 was declared the International Year of the Pulses at the 68th United Nations General Assembly (A/RES/68/231). The term pulses is restricted to crops harvested solely for dry grain as noted in the UN resolution, including beans, chickpeas, peas and lentils but the importance of legumes in agriculture transcends the production of grains since they have an increasing role as forage or they can be used as green manure.

This special issue covers significant topics including plant adaptation, agronomy, breeding, biotic & abiotic stresses and quality in both pulses and forage species. All these topics were addressed during the Second International Legume Society Conference, held in Troia, Portugal, in October 2016 and many of the articles published in this issue are related to results reported during this conference.

The opening article of this issue highlights the importance of flowering time in plant adaptation (Catt and Paull 2017). These authors explore the variation in flowering time in faba bean in order to breed new lines with higher yield and adapted to specific environments. After this, several articles report advances in agronomy and field testing which are important to demonstrate the beneficial properties of legumes in cropping systems and for the identification of cultivars with wide or specific adaptation to different growing conditions.

Despite the beneficial role of legumes, their cultivation area is very limited compared to cereals, but the design of new cropping systems including grain legumes may contribute to increase the sustainability in European farming systems (Pelzer et al. 2017). The assessment of cultivars stability in different environments is an important tool to select appropriate cultivars for specific growing conditions as shown in field pea (Iglesias-Garcia et al. 2017). Similarly, the existence of G×E interaction is also significant in cowpea (Martos-Fuentes et al. 2017) which highlights the opportunities to develop new cultivars adapted to specific sites.

Advances in agronomy and breeding of pastures have also been addressed in this issue. The performance of legume-grass mixtures and pure stands for forage production was compared in different Mediterranean drought-prone environments (Annichiarico et al. 2017), which is relevant to determine the best option for forage production in each site. In the same way although grass-legume mixtures are key crops to improve agriculture sustainability the performance of cultivars may differ between monoculture and mixture cropping systems (Maamouri et al. 2017). These authors found significant changes in ranking of cultivars depending of the growing system, and thus they suggested that the improvement of lucerne varieties should consider both growing systems. All these findings are important for breeding and highlight the importance of identifying the purpose of new cultivars. In this context Pecetti and Annichiarico (2017) assessed the amount of genetic variation in breeding grazing-tolerant lucerne, and found that there is large variation available although extensive evaluation is required.

Plant breeding is a slow process which requires the evaluation of large numbers of genotypes. Thus the development of new protocols allowing shorter times and higher selection efficiency are very appreciated by breeders and researchers. The new in vitro-assisted protocol developed by Pazos-Navarro et al. (2017) allowed the production of several generations per year (between 2.7 and 6.1) using subterranean clover as a case study. This achievement opens new possibilities for plant breeding and to speed up the development of mapping populations such as Recombinant Inbred Lines for genetic studies. It is well known that marker assisted selection (MAS) is useful to improve the selection efficiency, but it is important to show specific results to remind the advantages of MAS. In this context Gil et al. (2017) reported the effectiveness of this technique in chickpea for the