Is selection at low plant density effective? A paradigm with a lentil landrace

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INTRODUCTION

Lentil crop, adaptable to marginal environments [1], has been cultivated for 10,000 years [2]. It's productivity has increased more than 50% since the middle of 20 century averaging now 1t/ha, and ranks sixth in production among the major pulses [3]. Significant yield increase can be achieved through plant breeding, crop management and management of the genotype by environment G×E interaction [4]. Absence of competition has been asserted to optimize plant selection within a lentil (*Lens culinaris* spp) landrace, particularly when tolerance to viruses is sought. The aim of this study was to investigate progress of selection at two very low plant densities according to the honeycomb breeding [4].

MATERIALS AND METHODS

Two non-replicated (NR-0) honeycomb experiments including 1000 plants each were established at the farm of the Fodder Crops and Pastures Institute in Larisa, Greece, at the ultra-low density (ULD) of 1.8 plants/m² and the low density (LD) of 4.6 plants/m². The famous for its quality landrace "Eglouvi" from Lefkada, Greece, was used as the source material [4]. Fifteen highest yielding and healthy plants were selected from each experiment and progeny testing was carried out in honeycomb R31 experiments at two locations, Larisa (Site 1) and Orestiada (Site 2) (Fig. 1a, 1b, 2a, 2b, 2c, 2d). Measurements of grain yield per plant was recorded.

FIG. 1. Locations of experimentation (1a) and the R-31 honeycomb design (1b).

FIG. 2. The R-31 honeycomb experiment (2a, 2b) , single plants (2c) and the formation of ring in the field (2d).

RESULTS AND DISCUSSION

The first year of experimentation (2010-11) the landrace "Eglouvi" was evaluated at two non-replicated (NR-0) honeycomb experiments, at the ultra-low density (ULD) of 1.8 plants/m² and at the low density (LD) of 4.6 plants/m². The mean yield per plant and coefficient of variation (CV) were 3.6 g and 162%, respectively, at the ULD, and 4.7 g and 140%, respectively, at the LD (Fig. 3). Very low densities favoured aphid-transmitted viruses leading to huge pant-to-plant variability. Fifteen highest yielding and healthy plants were selected from each experiment, averaging 25.8g, forming thus 30 single-plant sister lines. Progeny testing was carried out in honeycomb R31 experiments at two locations, Larisa (Site1) and Orestiada (Site2) (Fig. 1a). There were no significant differences between the lines originated from the two density regimes (Fig. 4). Four sister lines at Site 1 and five sister lines at Site 2 had higher yield against the mother population (up to 19.9% at Site 1, and up to 44.9% at Site 2). Five sister lines at Site 1 and eight at Site 2 had lower CV compared to the mother population (up to 27.5% at Site 1, and up to 24.1% at Site 2). Four lines were of the highest yielding and having the lowest CVs at both Sites.

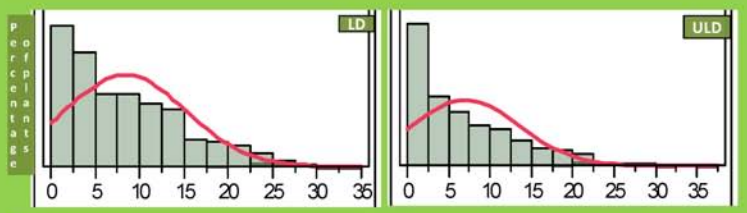

FIG 3. Yield distribution (gr/plant) of mother's population productive plant at low density (LD) and ultra low density (ULD) (*15 selected plants represented with dark color at the right side of each distribution*)

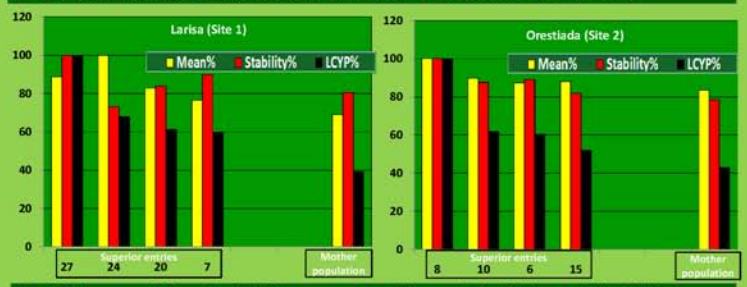

FIG. 4. Performance of 4superior lentil lines compare to mother population (%) (mean yield, stability, LCYP) in Larisa (Site 1) and Orestiada (Site 2).

CONCLUSIONS

❑ There was a sign of considerable improvement in the aim to obtain pure-line genotypes. Four lines were of the highest yielding (~18%) and having the lowest CVs at both Sites, in only one year selection (Fig. 4).

❑ The density regime (UL and ULD) did not affect the selection effectiveness; rather, at ULD lower yield and higher CV indicated higher spatial heterogeneity.

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Ευρωπαϊκή Ένωση
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