Evaluation of yield gap associated with crop management in rapeseed productionusing comparative performance analysis (CPA)and boundary-line analysis (BLA) methods in Neka region

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Extended Abstract

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Introduction: Since projections show that the world's population will surpass nine billion by 2050, future world food security depends on the adequate food production for the world's burgeoning population. Achieving food security under the current circumstances depends on the realization of the crop potential yield in the field (Hochman *et al.,* 2016). Hence, improving the crop yield is necessary in view of the increasing pressure and global demands for food. On the other hand, loss of high quality land, annual decline in crop yield, increased use of chemical fertilizers and the adverse environmental impact of chemical inputs indicate that the development of new strategies to increase yield with minimum environmental impact is necessary (Chapagain & Good, 2015). Moreover, ensuring environmental sustainability can lead to change in agricultural management practices (Gaydon *et al.,* 2017). As noted, many factors prevent farmers from achieving the attainable crop yield. It seems that, by determining the effect of each management-related factor on the amount of yield gap, and consequently, the knowledge of the farmers, it is possible to minimize the yield gap between the actual yield and the achievable yield. Therefore, this research was conducted with the aim to determine and rank the factors contributing to the rapeseed yield gap under the climate of Neka region, Mazandaran province in Iran.

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Material and Methods: The research was carried out in 100 rapeseed fields in Neka, Mazandaran province, Iran from 2015-16 to 2016-17. Most of the management practices from seedbed preparation to harvest were recorded through field studies. Field identifications were done in a way that included all the main production procedure in the specific region with variation in management view point. The final CPA model, the average paddy yield was calculated by the model by placing the observed average variables (Xs) in the fields under study in the yield model. Thereafter, by putting the best observed value of the variables in the yield model, the maximum attainable yield was calculated. The difference between these two was considered as yield gap. In the boundary line analysis (BLA), by plotting scatter plot for the actual yield in the region as a dependent variable against independent variables (14 important and first-grade variables), a function was fitted into the upper edge of the data dispersion.

Results and Discussion: With approximately 150 variables under the study, the final model with seven independent variables including soybean pre-sowing, rice pre-sowing, top dressing, potassium application, nitrogen application at vegetative stage, herbicide and pesticide application frequency and weed problem were plotted against the depended variable of paddy yield. The yield gap caused by top dressing and potassium application was 462 and 294 $kgha^{-1}$, which, respectively, contributed 27% and 17% to the total yield gap. The yield gap related to the effect of soybean pre-sowing and herbicide application frequency was 170 and 411 $kgha^{-1}$, which, respectively, contributed 10% and 24% to the total yield gap. In yield model constructed by CPA method, the actual yield and calculated potential yield were 2394 and 4119 $kgha^{-1}$, respectively. The total yield gap was estimated to be 1725 $kgha^{-1}$. According to the BAL method, the average yield, based on the optimum level of the 14 studied variables, was 3070 $kgha^{-1}$ with a 1019 $kgha^{-1}$ yield gap per hectare. The average relative yield and relative yield gap for the 14 investigated variables were 67.51% and 32.50% respectively.

Conclusion: Among the seven variables entered in the model, the effects of potassium consumption, soybean pre-sowing, top dressing and herbicide application frequency were remarkable. Therefore, a significant part of the yield gap can be compensated by managing potassium application rates and employing integrated pest control. The findings of this study show that the model precision is accurate and can be applied for both the estimation of the quantity of yield gap and the determination of the portion of each limiting yield variable. It can be concluded that the use of BLA in yield gap studies can clearly show the yield responses to management factors and calculate the possible potentials. Thus, appropriate management of cultivation practices in the fields can lead to increased yield and

reduced yield gap.

Keywords: Attainable yield, canola, comparative performance analysis, boundary-line analysis, management factors

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