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The interrelationships of chickpea (*Cicera rietinum* L.) kernel yield and its components under rainfed conditions

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ABSTRACT-Chickpea (*Cicer arietinum* L.) is a native crop of Asia which is grown worldwide including Iran. In this study, different selection criteria including correlation, regression and path analysis were used to improve yield. The experimental design was split plot with RCBD replicated four times in which three sowing dates (5 January, 4 February, and 5 March) were used in main plots and four genotypes; two semi bush types and early mature cultivars(ILC$_{482}$ and Flip$_{84-42}$) and two stand types and late mature ones (Hashem and Arman), were allocated to subplots. Results showed that Flip$_{84-42}$ variety and 5 January sowing date had the highest amount of kernel yield, pod number per plant, kernel number per pod, 100 kernel weight, biological yield, and days to flowering. There was a positive correlation between the kernel yield and pod number per plant ($r=0.57^{**}$, $p\leq0.05$), kernel number per pod ($r=0.51^{**}$, $p\leq0.05$), biological yield ($r=0.39^{*}$, $p\leq0.05$), plant height ($r=0.31^{*}$, $p\leq0.05$), branch number ($r=0.22^{*}$, $p\leq0.05$), leaf area index ($r=0.59^{**}$, $p\leq0.05$), and first pod height ($r=0.58^{**}$, $p\leq0.05$). Regression analysis also showed that yield was determined by biological yield, leaf area index and days to flowering. Results of path analysis revealed that biological yield had the greatest direct effect on kernel yield ($p=0.61^{**}$, $p\leq0.05$). This character was followed by number of pods per plant ($p=0.31^{*}$, $p\leq0.05$) and leaf area index ($p=0.35^{*}$, $p\leq0.05$). Results of this study indicated Flip$_{84-42}$ and5 January are the best variety and sowing date to cultivate chickpea in Badjgah region under dryland condition. In addition, it can be concluded that rainfed chickpea breeders should pay attention to the traits such as biological yield, leaf area index and days to flowering when selecting high-yielding genotypes.

INTRODUCTION

Chickpea (*Cicer arietinum* L.), a native crop of southwest Asia, is among the first crops to be cultivated by human. Its wild relatives are still found in Afghanistan, Iran and Ethiopia (Oelke et al., 1991). This crop has been grown in Iran. The leading countries in pea production include Russia, China, India, Canada, and the United States. In Iran, rainfed chickpea is mostly produced in Kermanshah, Lorestan, Azerbaijan and Fars provinces where the area under cultivation in 2010 was estimated to be over 409000 ha with 218000 ton production (Anonymous, 2011). Sowing date affects yield through affecting response to day length and temperature. Inappropriate planting date causes the vegetative and reproductive growth period of the plant to encounter unsuitable conditions of day length or temperature. Reduction of growth period or confronting the critical plant growth stages with the adverse conditions of temperature can reduce growth and yield components and even cause the plant death (Khajehpour, 2000). Yield loss in chickpea can vary between 30% and 60% depending on genotype, sowing time, location, and climatic conditions during sowing season. Some chickpea genotypes have capacity to tolerate drought and in that case sowing time can be delayed. However, too early or late sowing causes drastic yield reduction and net profit compared with timely sowing (Dixitet al., 1993).

Traditionally, plant breeders have optimized yield mainly by empirical selection with little attention to the physiological processes involved in yield increase (Singh and Singh, 2004). More recently, strategies to optimize yield in pea have focused on the physiological mechanisms involved in the seed setting and fruit filling (Ranjan et al., 2006). However, selection of high yielding cultivars via specific traits requires knowledge of not only final yield but also various compensating mechanisms among yield components which result from genotypic, environmental and management factors. Grain yield of pea is a quantitative trait which is affected by many genetic and environmental factors (Ceyhan and Avci, 2005).Since grain yield is a complex trait, indirect selection through correlated, less complex and easier measurable traits would be an advisable strategy to increase it. Efficiency of indirect selection depends on the magnitude of correlations between yield and target yield components (Bhatti et al., 2005).In agriculture, correlation coefficients in general show associations among characteristics. It is not sufficient to describe this relationship when the causal association among characteristics is needed (Toker and Cagirgan,