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ORIGINAL ARTICLE

Variability of Nutrient Uptake and Grain Yield in Chickpea (*Cicer arietinum* L.) Varieties with Diverse Geographic Origins

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ABSTRACT
The grain yield of chickpea in Iran is low and instable, which may be attributed to the evolution of cultivars with narrow genetic base making them vulnerable to biotic stresses. In this experiment fifty chickpea varieties from diverse geographic origins were chosen and arranged randomized in augment experiment. Grain yield (kg/ha) ranged from 213.89 to 2566.67 with a mean value of 1172.35 kg/ha. The highest grain yield was belonging to Arman and ILC 263 cultivars. The positive correlation (0.16) was observed between grain yield and nitrogen content. The highest grain N belonged to Arman and ILC 263 cultivars. The highest grain P was observed in Flip 03-152c. Phosphorus content (%) ranged from 0.23 to 0.79 with a mean value of 0.46 %. The negative correlation (-0.088) was observed between the N and P of chickpea cultivars. The highest K content was observed in C421 cultivar (Cyprus).
***Key words**: cultivar, genotype, nitrogen, yield.*

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important pulse crop, ranking second in growing area (15.3% of total pulse area) and third in production (14.6% of total pulse production) around the world [1]. Two main chickpea market classes are recognized, kabuli (white flower with large, cream-coloured seeds) and desi (purple flower with smaller, angular, dark-coloured seeds). Seed legumes are a good source of complex proteins, carbohydrates and dietary fiber. Chickpea protein is rich in lysine and arginine but most deficient in sulphur-containing amino acids methionine and cystine [2]. Chickpea is also a good source of absorbable Ca, P, Mg, Fe and K. Legume grains comprise an important part of the human diet in developing countries. Seed storage constituents such as protein are affected by both genetic make-up and the environment [3]. The grain yield of chickpea in Iran is low and instable, which may be attributed to the evolution of cultivars with narrow genetic base making them vulnerable to biotic stresses. Cultivar with narrow genetic base emerged due to the extensive use of few and closely related germplasm lines in crop improvement program. Diverse genetic backgrounds of parental lines provide the allelic variation necessary to create favorable new gene combinations. The genetic diversity among and within landraces makes them a valuable resource as potential donors of genes for breeding purposes, diversification of production, developing new farming systems and new quality products [4]. Today it is realized that the use of genetically different varieties is an effective strategy in order to minimized genetic vulnerability [5].

The aim of the present work was determining the suitable chickpea genotypes having the features of high yield, some qualitative traits and chemical characters, as well as interrelations between them in a collection of diverse geographic origins types.

MATERIALS AND METHODS

Site description and experimental design

Field experiment was conducted at Islamic Azad University of Sanandaj (11°45′ lat. N; 30°47′ long. E, 1400 m above sea level) in Kurdistan province of Iran, in 2012 growing season. This farm had been sown by wheat at last year. The annual temperature averages 12 °C and the annual rainfall averages 512 mm. Some of the soil physicochemical properties of farm in the surface layer (0–25 cm) were: clay-loam texture (29% sand, 41% clay and 30% silt), pH 7.31 (1:2.5 in water), 1.18% OM, 0.21% total N, 212 mg kg^{-1} extractable K^+ (NH_4Ac) and 7.1 mg kg^{-1} Olsen P.

Fifty chickpea varieties from diverse geographic origins were chosen and arranged randomized in augment experiment. Genotypes include: 17 improved breeding lines were obtained from the International Center for Agricultural Research in the Dry Areas (ICARDA), Alepo, Syria, 28 Iranian landrace chickpea (*Cicer arietinum* L.) accessions from different geographical location of Iran provided by Seed and Plant Improvement Institute, Karaj, Iran, and five improved cultivars (ILC263, Arman, Hashem, ILC3279 and Pirooz) that used in most of chickpea cultivation area of Iran (Table 1).

Table 1. List of chickpea accessions used in this study.

No.	Genotypes	Source	No.	Genotype	Source
1	Flip00-17C	ICARDA	26	Landrace17	Iran-Esfahan
2	ICCV92311	ICARDA	27	Landrace18	Iran-Jiroft
3	Flip94-30C	ICARDA	28	Landrace19	Iran-Torbat
4	ICCV96325	ICARDA	29	Landrace20	Iran-Karaj
5	ICCV03111	ICARDA	30	Landrace21	Iran-Karaj
6	ILC 263	ICARDA	31	Flipo 03-153c	ICARDA
7	Landrace1	Iran	32	Flipo 03-45c	ICARDA
8	Arman	Iran	33	Flipo 00-14c	ICARDA
9	SEL 93TH	Iran	34	Flipo 03-152c	ICARDA
10	Hashem	Iran	35	Flipo 96-154c	ICARDA
11	Landrace2	Iran-Kerman	36	Flipo 03-38c	ICARDA
12	Landrace3	Iran-Torbat	37	Flipo 03-19c	ICARDA
13	Landrace4	Iran-Karaj	38	Flipo 02-59c	ICARDA
14	Landrace5	Iran-Esfahan	39	Flipo 03-147c	ICARDA
15	Landrace6	Iran-Esfahan	40	ILC 3279	ICARDA
16	Landrace7	Iran-Ardabil	41	Flipo 02-58c	ICARDA
17	Landrace8	Iran-Jiroft	42	Kaka	Iran-Kurdistan
18	Landrace9	Iran-Torbat	43	Pirooz	Iran
19	Landrace10	Iran-Ardabil	44	ICC V2	ICARDA
20	Landrace11	Iran-Esfahan	45	C421	Landrace-Cyprus
21	Landrace12	Iran-Shiraz	46	C419	Landrace-Cyprus
22	Landrace13	Iran-Torbat	47	C426	Landrace-Cyprus
23	Landrace14	Iran-Esfahan	48	C412	Landrace-Cyprus
24	Landrace15	Iran-Khoee	49	C425	Landrace-Cyprus
25	Landrace16	Iran-Karaj	50	Flipo 02-168c	ICARDA

Mesorhizobium sp. cicer strain SW_7 was added to all the chickpea seeds. Chickpea seeds were planted on March 1, 2012. Each genotype was sown 5 m in length, with 35 cm inter-row spacing, in 3 rows. Weeds were removed manually in all plots. The field was irrigated four times with three a day interval for the better germination of seeds, then the plots were irrigated to maintain a moisture level of 0.33 bars (i.e. field capacity) (moisture level was measured using Tensiometers installed in the field).

Seed analysis

Data on grain yield and other traits were taken and recorded from the middle row in each cultivar. The phosphorus and nitrogen content of matured seeds was determined by vanado molybdate phosphoric acid yellow colour method and microkjeldahl method, respectively (Jackson, 1973). Also, the potassium content was determined by flame photometer model-EEL [6].

Statistical analysis

The data collected in this study was subjected to analysis of variance (ANOVA) and the LS means was used to compare means of traits ($p < 0.05$). In addition correlation coefficients among traits were also determined.

RESULTS AND DISCUSSIONS

Analysis of variance on the studied traits showed significant differences among genotypes for all the measured characters. The variability between genotypes was high for all traits ($P<0.01$), indicated that differences existed between the accessions for yield and other yield related traits. The experimental coefficient of variation (CV) varied from 6.9 to 11.2. In general, CV value lower than 20% is considered to be good, indicating the accuracy of conducted experiments. Grain yield (kg/ha) ranged from 213.89 to 2566.67 with a mean value of 1172.35 kg/ha. High differences between the maximum and minimum mean values were found for all other traits. This considerable variability provides a good opportunity for improving traits of interest in chickpea breeding programs. The highest grain yield was belonging to Arman and ILC 263 cultivars (Fig. 1). Seed yield is a complex trait that receives the interactive effects of many other plant traits, which are in turn influenced by their genetic structures and the environment where the plant is grown. Thus the direct evaluation and improvement of seed yield itself may be misleading due to the influence of the environmental component. Therefore, it is essential to analyze the data for the relative contribution of various components to yield performance. The simple correlation is an important tool for this purpose. The positive correlation (0.16) was observed between grain yield and nitrogen content. The highest grain N belonged to Arman and ILC 263 cultivars (Fig. 2). The highest grain P was observed in Flip 03-152c. Phosphorus content (%) ranged from 0.23 to 0.79 with a mean value of 0.46 % (Fig. 3). The negative correlation (-0.088) was observed between the N and P of chickpea cultivars. The highest K content was observed in C421 cultivar (Cyprus) (Fig. 4).

The description of qualitative important and useful characteristics is an important prerequisite for effective and efficient utilization of germplasm collections in breeding programs. A small mini core collection of landrace, breeding line and improved chickpea cultivars has been assembled and we have shown that there is a high level of morphological diversity for most of the traits observed, which may be useful for future breeding endeavors. The exploitation of crosses between genetically distant parents and those from diverse local sources may produce higher heterosis, better genetic recombination and segregation in their progenies and result in varieties with broad genetic base [7]. There is an opportunity to bring about improvement of the crop yield through direct and indirect selection as well as improving of these characters through hybridization using the germplasm collections in Iran. Finally the Arman and ILC 263 selected as the best cultivars of our experiment.

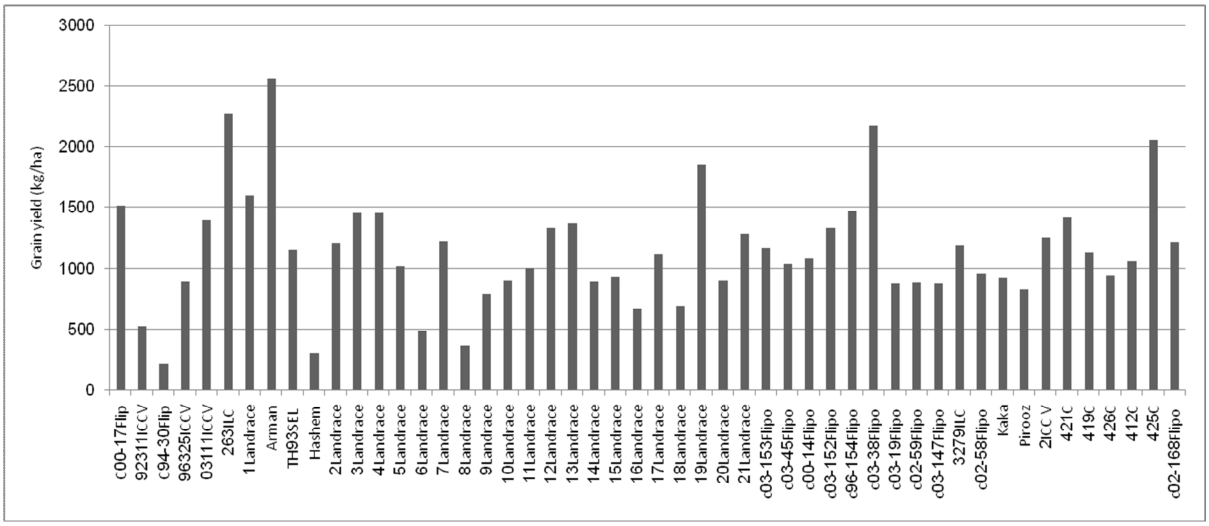

Fig. 1. The grain yield of chickpea cultivars (LS means).

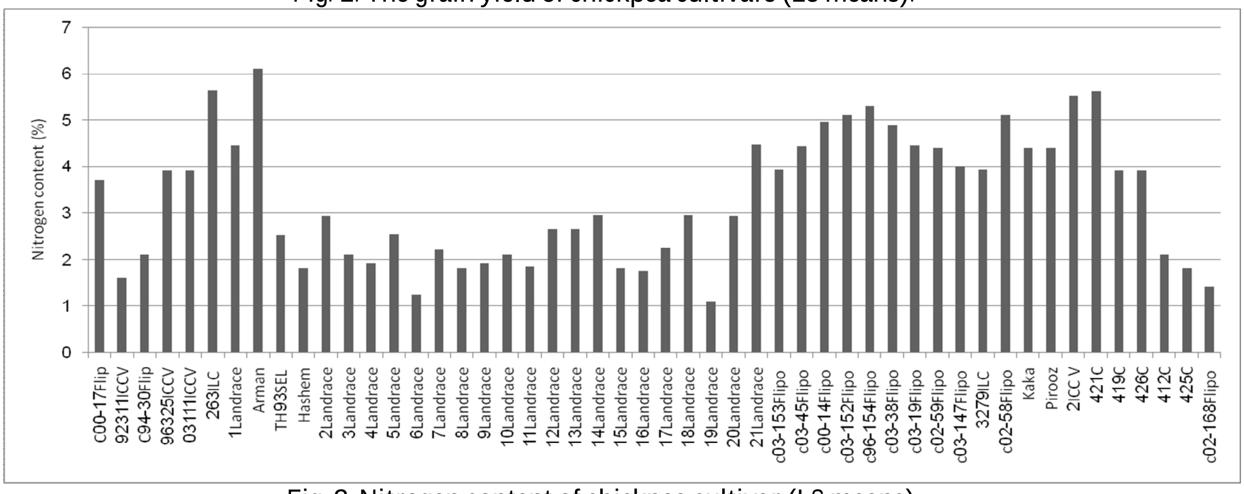

Fig. 2. Nitrogen content of chickpea cultivar (LS means).

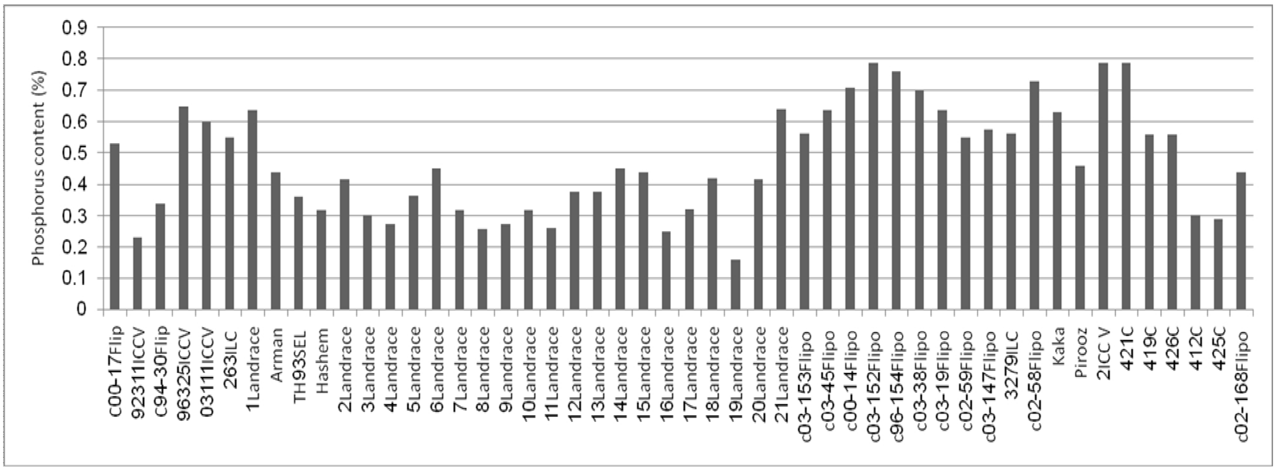

Fig. 3. Phosphorus content of chickpea cultivar (LS means).

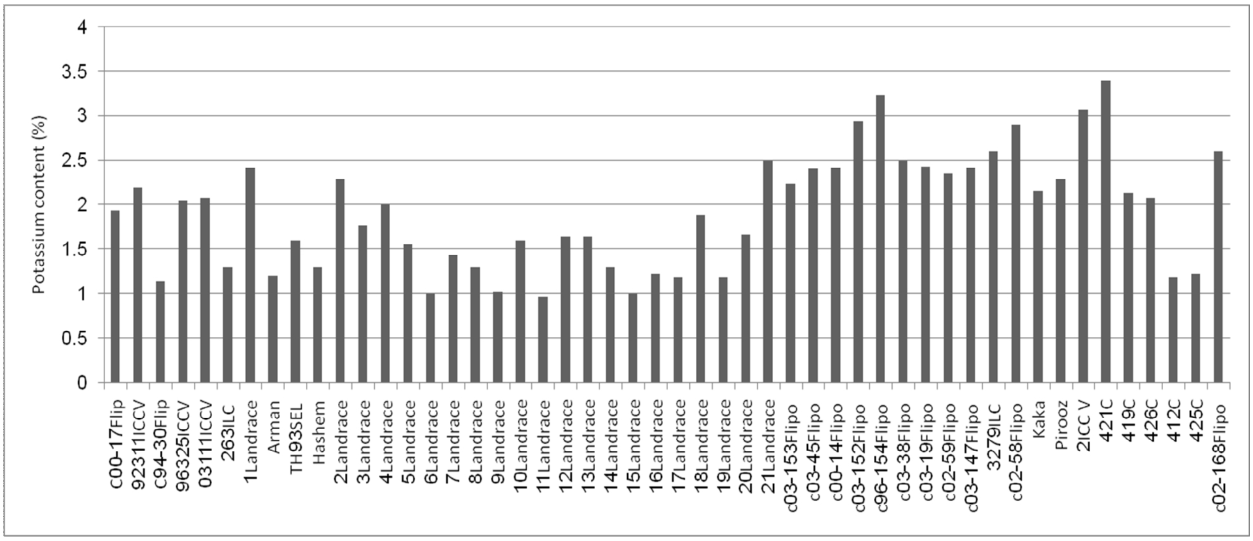

Fig. 4. Potassium content of chickpea cultivar (LS means).

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