Tikrit Journal for Agricultural Sciences (2022) 22 (3): 148-157
https://doi.org/10.25130/tjas.22.3.17

IRAQI Academic Scientific Journals
العراقية المجلات الأكاديمية العلمية

ISSN:1813-1646 (Print); 2664-0597 (Online)
Tikrit Journal for Agricultural Sciences
Journal Homepage: http://www.tjas.org
E-mail: tjas@tu.edu.iq

TJAS
Tikrit Journal for Agricultural Sciences

Growth, Yield, and Quality Characteristics of Eight Winter Chickpea Varieties Under Rainfed Conditions

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KEY WORDS:

Chickpeas, *Cicer arietinum*, Growth performance, Yield, Rainfed Agriculture

ARTICLE HISTORY:

Received: 10/04/2022
Accepted: 16/06/2022
Available online: 30/9/2022

ABSTRACT

This experiment was conducted aiming to introduce and select the suitable winter chickpea to Sulaymaniyah governorate climatic conditions. This study was laid out in RCBD design with eight different varieties (namely, FLIP 97-706C, FLIP 03-87C, FLIP 05-74C, FLIP 05-87C, FLIP 05-110C, FLIP 05-142C, FLIP 05-150C, and local Flip1 varieties), each with three replicates. The results indicated that the FLIP 97-706C variety had the highest yield (3531±2.1 kg ha^{-1}), protein yield (390±0.05 kg ha^{-1}), and weight of 100 seeds (39.0±0.05 g), significantly. Additionally, other introduced varieties also gave noticeably higher yields in comparison to the average global chickpea yield. The suggested varieties can have an important role in increasing and improving chickpea production and quality, especially, the FLIP 97-706C can be among the promising varieties with its large seeds, tall habit, and high yield for this area.

INTRODUCTION

Chickpea (*Cicer arietinum L.*) is an annual legume of the family Fabaceae that is originally native to Iraq, Iran (RBG Kew, n.d.), the southeast of Turkey and the north of Syria (Van der Maessen, 1972). It is an essential food as a source of protein in many regions of the world, particularly in Asia and Africa, since it is a drought-tolerant cool-season legume crop. It is consumed in great amounts in Southeast Asia, the Middle East, and Mediterranean countries (CGIAR, 2008). The highest per capita consumption of chickpea is Turkey (6.65 kg year^{-1}) followed by India (5.37 kg year^{-1}), Myanmar (4.54 kg year^{-1}), Jordan (4.27 kg year^{-1}) and Pakistan (4.11 kg year^{-1}) (Yadav et al., 2007). Legumes are sometimes referred to as "poor man's meat" and are an important part of a vegetarian's diet because they play an essential nutritional function in human diets, mainly in developing countries (Latham, 1997). Chickpeas protein is superior to that found in other legumes (Jukanti et al., 2012). Additionally, chickpea has high contents of calories, carbohydrates, protein, vitamins, fibre, calcium, iron, phosphorus, and other minerals, as well as

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phytochemicals that may be beneficial to human health (Wood and Grusak, 2007) and are used in many processed forms, or as feed (Kumara and Deb, 2014). Also, it is a cost-effective and accessible crop for developing countries (Malunga et al., 2014; Redden and Berger, 2007). It is mainly planted in the arid and semi-arid and produced in more than 50 countries around the world (Varshney et al. 2019). India is considered the world's largest producer of chickpeas, with a total production of 9.075 million tons, followed by Australia, Myanmar, Ethiopia, Turkey, Russian Federation, Pakistan, the United States of America, Iran, Mexico, Yemen, Malawi, Morocco, and Syria (Merga and Haji, 2019; Rawal and Navarro, 2019).

Chickpeas planted area was 30,699 dunam (1 Iraqi dunam = 2,500m^2) in the Kurdistan region in 2012-2013 and its production was estimated at 3,481 tonnes with a yield of 113.4 kg dunam^{-1}. This has changed to 27,010 dunams 8,569 tonnes yield 317 kg dunam^{-1} in 2019-2020. The largest area of 11,353 dunams (42.03%) under chickpeas cultivation has been recorded in Sulaymaniyah governorate with a higher yield of 400 kg dunam^{-1} and production rate (52.99%) of 4,541 tonnes (KRSO, 2021). Figure (1) shows chickpeas crop production in Sulaymaniyah Governorate between 1995 to 2020. It can be seen from the data that despite the increase in yield, the total production has significantly decreased due to the import of chickpeas from other countries such as the USA, Mexico, and Turkey for cheaper prices and the unavailability of combine harvester for the local dwarf chickpea varieties. Additionally, because of its function in nitrogen-fixing, chickpea is frequently cultivated in rotation alongside other cereals, mainly wheat and barley, in Kurdistan Region.

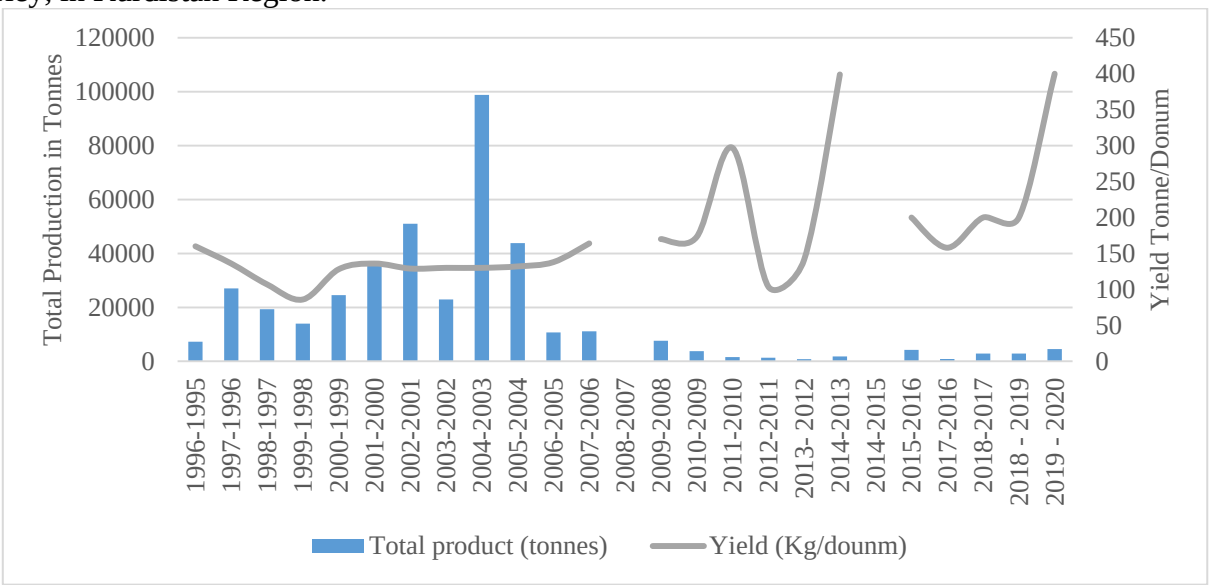

Figure (1): Chickpea crop production in Sulaymaniyah Gov. (Source: KRSO, 2021)

Various varieties of chickpea are cultivated in the world, but for the Kurdish farmers, only some of the spring varieties are commonly known. As a result, production has fluctuated during the last few decades (KRSO, 2021). The Kurdistan region farmers are recently getting familiarized with some of the newly introduced winter varieties of chickpeas, but there is a lack of information about the productivity of winter chickpea varieties. There are a couple of recent studies regarding the winter varieties of chickpea in Sulaymaniyah governorates such as a study conducted by Hamma-Umin (2019) on the stability and yield performance of seven winter chickpea varieties, and similarly, Ahmed et al. (2018) investigated the growth traits and yield of five winter chickpeas varieties in Bakrajo district, Sulaymaniyah governorate. One of the key points of successful farm productivity is crop development and the selection of high-quality varieties that are suitable to the region's climate. So, this field experiment was conducted to evaluate the adaptability of newly introduced winter chickpea varieties in the Sulaymaniyah Governorate, Kurdistan Region of Iraq, and to select the varieties that are tolerant to harsh climates with high quality, and quantity yield, large seed size that meet consumers' demand, and resistant to diseases and pests to achieve food security.

MATERIALS AND METHODS

This experiment was conducted at the experimental field of the Research Centre in the Directorate of Agriculture and Water Resources of Sulaymaniyah, Bakrajo district, Sulaymaniyah City, Kurdistan Region of Iraq. Sulaymaniyah governorate is characterized by a cold, rainy and snowy winter, and also hot and drought summer. This means it has a humid climate in winter and an arid climate in summer due to zero precipitation in the summer. The average annual temperature recorded between 1941-2015 was 19°C and the mean annual precipitation total of 715 mm (Mustafa et al 2018).

This research was designed in a completely randomized block design CRBD. It was sown with eight varieties of chickpeas received from ICARDA (International Center for Agricultural Research in the Dry Areas) namely, FLIP 97-706C, FLIP 03-87C, FLIP 05-74C, FLIP 05-87C, FLIP 05-110C, FLIP 05-142C, FLIP 05-150C, and local Flip1 varieties, with three replications. Each block (0.8×4 m^2) included four rows, with row spacing of 0.2m, and plant spacing of 0.1m. The seeds were sown 160 seeds per plot with an optimum plant density for chickpea of 50 seeds m^{-1} (Gan, et al., 2003) on 4th of December 2012. All of the agricultural practices were applied equally during the growing season. DAP fertilizer (160 kg ha^{-1}) was applied and the weed was controlled with a chemical herbicide. The first rainfall after sowing was on 5th of December 2012.

Weight of 100 seeds was measured using a balance. Then germination percentage was tested in the laboratory by sowing 100 seeds on a tray filled with a layer of sieved (particles size of 4mm) and moist sand, incubated at room temperature with maintained moisture of the sand. After 10 days the germinated seeds were counted daily based on the seedling evaluation procedure explained in the handbook of the association of official seed analysts (AOSA, 1990) and normal and abnormal seedlings were separated according to the international rules of seed testing by the International Seed Testing Association ISTA (1996) and calculated using the following equation:

$$\text{Germination Percentage} = \frac{Number\ of\ germinated\ seeds}{Total\ number\ of\ tested\ seeds} \times 100 \quad \text{..... (equation 1)}$$

The emergence percentage was calculated with the following equation (Carlson and Clay, 2016) while the number of emerged seedling were counted for 30 days from the sowing date, as emergence in chickpea occurs between 7 to 30 days after sowing, depending on the depth of sowing, as well as, soil moisture and temperature (GRDC, 2017):

$$\text{Emergence Percentage} = \frac{Number\ of\ emerged\ seedling\ at\ 30\ days}{Total\ number\ of\ sown\ seeds} \times 100 \quad \text{..... (equation 2).}$$

The other growth characteristics such as the number of tillers, number of nodes per plant, number of days to flowering, number of flowers per node, days to podding, and days to pod maturity were taken during the growing season.

Flowering period (days). At maturity, all the plots, an area of 3.2 m^2, were manually harvested on 26th May 2013. After harvest, the seeds were taken to the laboratory for further yield and quality parameter measurements.

The total seed yield, the 100 seed weight, and the shoot system biomass were measured using a weight scale and the total protein was determined by the Kjeldahl distillation method then the protein percentage was multiplied by the yield to calculate protein yield (kg ha^{-1}).

The harvest index (HI) was calculated using the following formula:

$$\text{Harvest Index (HI)} = \frac{\text{The Ratio of Grain}}{\text{Total Shoot Dry Matter}} \quad \text{..... (equation 3).}$$

The collected data were analyzed with XLSTAT software. ANOVA, and correlation coefficient analysis were used to show the relationship and differences within the studied variables.

RESULTS AND DISCUSSION

Results in table (1) showed a high germination percentage for all the seeds of the varieties, and it was over the accepted percentage of over 85%. The lowest germination% was recorded with FLIP 05-150C (%96) followed by FLIP 97-706C (%98), which were significantly different (*p-Value* =0.001) from the rest of the varieties which recorded (%100) of germination rates. The FLIP 97-706C and FLIP 05-150C varieties had a significantly higher weight of 100 seeds before sowing (39.0±0.58 and 39.0±0.58), respectively. No significant differences were found for the emergence

time while both FLIP 97-706C and Local Flip1 had significantly higher emergence percentages (%95±0.58, and %95±0.58), respectively. The number of survived plants per square meter was significantly more in FLIP 97-706C, and FLIP 05-142C(39±0.58, and 39±0.57 Plants seq. m^{-1}), respectively compared to other varieties except for local Filip 1 (38±0.54 Plants seq. m^{-1}). Overall, all the studied varieties were of an acceptable standard and the FLIP 97-706C variety had superlatively better characteristics of seed traits among all the eight studied chickpea varieties.

Table (1): Seed and seedling characteristics of studies chickpea varieties

Varieties	100 seeds weight (g) before sowing	germination % (Lab.)	emergence %	days to emergence	no. of plant seq. m^{-1}
FLIP 97-706C	39.0±0.58a	98±0.00b	95±0.58a	22±0.61a	39±0.58a
FLIP 03-87C	33.7±0.41c	100±0.00a	90±1.16b	21.3±0.58a	34±1.15cd
FLIP 05-74C	35.5±0.29b	100±0.00a	88±0.58b	20.7±0.12a	32±0.57d
FLIP 05-87C	32.4±0.23d	100±0.00a	83±0.57c	21±0.12a	34±0.58cd
FLIP 05-110C	30.6±0.35e	100±0.00a	85±0.57b	20±0.57a	36±0. 58bc
FLIP 05-142C	34.0±0.58c	100±0.00a	90±0.58c	22±0.46a	39±0.57a
FLIP 05-150C	39.0±0.58a	96±0.00c	88±0.85b	20±0.45a	35±0.58c
Local Flip1	27.2±0.12f	100±0.00a	95±0.58a	20±0.67a	38±0.54ab
P-Value	0.000	0.001	0.000	0.917	0.000

The correlation coefficient analysis results in table (2) show a significantly negative coefficient (-0.626, P<0.001) between the seed size and germination percentage.

Table (2): The correlation coefficient between the studied seed traits of chickpea varieties

Variables	100 seeds weight (g) before sowing	germination % (Lab.)	emergence %	days to emergence	plant seq. m^{-1}
100 seeds weight (g) before sowing	1				
germination % (Lab.)	-0.626**	1			
emergence %	0.039 $^{n.s.}$	-0.122 $^{n.s.}$	1		
days to emergence	0.064 $^{n.s.}$	-0.095 $^{n.s.}$	0.092 $^{n.s.}$	1	
no. of plant seq. m^{-1}	-0.075 $^{n.s.}$	-0.164 $^{n.s.}$	0.635**	0.056 $^{n.s.}$	1

* a significance level alpha=0.05; ** a significance level alpha=0.01; n.s. non-significant

Table 3 showed that there were no significant differences in the number of branches, flowers per nod, days to podding, days to maturity, and flowering periods in days among the introduced varieties. Regarding the height of the plants, which were measured in full growth, the FLIP 97-706C variety recorded the highest plant height (84.33±1.52 cm, *p*-Value=0.000). However, the shortest plant height was with the Local Flip1 (69.00±1.00 cm, *p*-Value=0.000). High plants help Kurdistan region farmers to harvest using combine harvester, while this was impossible for the local varieties due to their shortness. Additionally, significant differences were found in the number of nodes per plant which FLIP 05-110C variety recorded the biggest number of nods per plant (35±0.57 no. of nods $plant^{-1}$, *p*-Value=0.000) and more days to flower (127±0.58 days, *p*-Value=0.003) while FLIP 97-706C needed significantly fewer days to flower (123±0.38 days). No significant correlation coefficient between plant growth and flowering traits.

Table (3): Plant growth and flowering trait characteristics of the studies chickpea varieties

Varieties	plant height (cm)	no. of branches	no. of nods $plant^{-1}$	days to flower	no. of flowers nod^{-1}	flowering period

						(days)
FLIP 97-706C	84.33±1.52a	3±0.29a	29±0.49cd	123±0.38c	1±0.00a	18±0.00a
FLIP 03-87C	79.67±1.53b	3±0.29a	31±0.58bc	124±0.93bc	1±0.00a	17±0.00a
FLIP 05-74C	77.67±4.04bc	3±0.29a	29±0.54cd	125±0.57b	1±0.00a	17±0.00a
FLIP 05-87C	79.67±2.52b	4±0.29a	23 ±1.14e	125±0.41b	1±0.00a	17±0.00a
FLIP 05-110C	77.67±3.52bc	3±0.29a	35±0.57a	127±0.58a	1±0.00a	17±0.00a
FLIP 05-142C	74.67±1.53cd	3±0.29a	33±0.34ab	124±0.92bc	1±0.00a	16±0.00a
FLIP 05-150C	72.33±2.08de	3±0.29a	27±0.50d	124±1.58bc	1±0.00a	18±0.00a
Local Flip1	69.00±1.00e	4±0.29a	33±0.65ab	123±0.58c	1±0.00a	16±0.00a
P-Value	0.000	0.715	0.000	0.003	--	0.176

Regarding the pod characteristics shown in table 4, the number of pods was significantly high in FLIP 03-87C, FLIP 05-110C and Local Flip1 varieties while pod was significantly longer in FLIP 05-74C and FLIP 97-706C varieties. The FLIP 05-110C varieties had a supremely more number of seeds per plant than other varieties. The height of the first pod was significantly high in FLIP 03-87C and FLIP 05-74C varieties (mean= 32±0.01, and 32±0.04 cm, respectively), and then in FLIP 97-706C and FLIP 05-110C varieties (31±0.05, and 31±0.01 cm, respectively) while the lowest was recorded with Local Flip1 (mean=28±0.02 cm). Shattering percentages were low among all the varieties. The highest recorded percentage was in Local Flip1, FLIP 05-110C, and FLIP 05-142C (mean= 3%, 2%, 2%), respectively.

Table (4): Pods trait characteristics of the studies chickpea varieties

Varieties	days to podding	no. of pods plant^{-1}	1st pod height (cm)	pod length (cm)	no. of seeds pod^{-1}	Shattering %
FLIP 97-706C	133±0.00a	24±0.08c	31±0.01ab	2.7±0.00ab	2±0.00a	1±0.00c
FLIP 03-87C	134±0.00a	29±0.09a	32±0.01a	2.4±0.02cd	2±0.00a	1±0.00c
FLIP 05-74C	135±0.00a	24±0.06c	32±0.04a	2.9±0.01a	2±0.00a	1±0.00c
FLIP 05-87C	134±0.00a	21±0.06d	30±0.01bc	2.4±0.00cd	2±0.00a	1±0.00c
FLIP 05-110C	135±0.00a	29±0.09a	31±0.05ab	2.4±0.00cd	2±0.00a	2±0.00b
FLIP 05-142C	133±0.00a	27±0.04b	30±0.01bc	2.6±0.00bc	2±0.00a	2±0.00b
FLIP 05-150C	133±0.00a	23±0.01c	29±0.00cd	2.4±0.01cd	2±0.00a	1±0.00c
Local Flip1	133±0.00a	28±0.01ab	28±0.02d	2.2±0.03d	2±0.00a	3±0.00a
P-Value	0.952	0.000	0.002	0.000	--	0.000

Correlation coefficient analysis results in table (5) showed a significantly negative coefficient between the shattering, and 1st pod height (-0.510, $P<0.05$) as well as, pod length (-0.448, $P<0.05$), and a positive coefficient (0.559, $P<0.05$) between the shattering, and number of pods per plant, among all the varieties.

Table (5): The correlation coefficient between the studied pod traits of chickpea varieties

Variables	days to podding	no. of pods plant^{-1}	1st pod height	pod length (cm)	shattering %
days to podding	1				
no. of pods/plant	-0.143 $^{n.s.}$	1			
1st pof height	0.228 $^{n.s.}$	0.122 $^{n.s.}$	1		
pod length (cm)	0.468*	-0.368 $^{n.s.}$	0.473*	1	
shattering %	0.033 $^{n.s.}$	0.559**	-0.510*	-0.448*	1

* significant at level alpha=0.05; ** significant at level alpha=0.01; n.s. not significance

According to data shown in table (6), it was observed that FLIP 97-706C recorded the highest yield (3531±2.1 kg ha^{-1}), and a significantly high protein yield (872.16 ±1.41 kg ha^{-1}), meanwhile, it also had a relatively similar weight of 100 seed after harvest (39.0±0.05 g) as the weight of 100 seed before sowing.

Table (6): Yield characteristics of the studies chickpea varieties

Varieties	days to maturity	no. of seeds plant^{-1}	100 seeds weight (g) after harvest	yield (kg ha^{-1})	protein %	protein yield (kg ha^{-1})
FLIP 97-706C	171±0.00a	27±0.00cd	39.0±0.05a	3531±2.1a	24.70±0.40c	872.16 ±1.41a
FLIP 03-87C	170±0.00a	31±0.01bc	34.0±0.06c	3375±2.0c	24.76±0.04bc	879.86±2.12a
FLIP 05-74C	170±0.00a	25±0.00de	37.0±0.01b	3218±2.2e	24.76±0.03bc	796.78±1.54c
FLIP 05-87C	170±0.00a	21±0.00e	34.0±0.00c	3375±2.4c	24.76±0.03bc	835.65±1.88b
FLIP 05-110C	170±0.00a	38±0.01a	31.0±0.04d	3343±1.9d	25.20±0.11b	842.44±4.29b
FLIP 05-142C	170±0.00a	26±0.00d	35.0±0.01c	3437±2.1b	26.07±0.03a	851.00±1.48b
FLIP 05-150C	171±0.00a	33±0.00b	39.0±0.01a	2968±0.5f	25.20±0.00b	747.94±3.86d
Local Flip1	169±0.00a	27±0.01cd	29.0±0.01e	3375±2.8c	25.20±0.10b	850.51±4.62b
P-Value	0.342	0.000	0.000	0.000	0.000	0.000

Overall, all the eight introduced varieties gave noticeably higher yields in comparison to the mean of yield of chickpeas production in the Sulaymaniyah Governorate (1.6 tonne ha-1) reported by KRSO (2021), and global chickpea yield which is equal to 1.8 tonnes ha-1 (Merga and Haji, 2019), and also higher than the winter varieties [Ghab 1 (Yield=1582.66 kg ha-1), and Filip 2 (Yield=1533.33 kg ha-1)] tested and introduced by Ahmed, et al. (2018) in the same area. This

experiment showed that the FLIP 97-706C could be among the promising varieties with its large seeds, tallness, and high yield. According to the recorded results, the tested winter varieties are much more promising for this region compared to the KRSO (2021) data that are mostly spring varieties cultivated spring season in the Kurdisran Region and Iraq (Rawal and Navarro, 2019). A study conducted by Hama-Ali (2018) reported that the further improvement is possible for the (FLIP 97-706C, FLIP 03-87C, FLIP 05-74C, FLIP 05-87C, FLIP 05-110C, FLIP 05-142C, FLIP 05-150C) genotypes through the breeding techniques, due to the existence of high variability among them.

Results in table (7) indicated that FLIP 05-150C had the heaviest hay weight (10.050±0.03) and biomass (7082.0±1.15). FLIP 97-706C, and FLIP 05-87C recorded the highest harvest index (0.380±0.00, and 0.380±0.00a) respectively.

Table (7): Biomass trait characteristics of the studies chickpea varieties

Varieties	hay weight (kg ha^{-1})	biomass (kg ha^{-1})	harvest index
FLIP 97-706C	5625.0±2.89de	9.156±0.00c	0.380±0.00a
FLIP 03-87C	6563.0±3.31bc	10.030±0.04a	0.340±0.00c
FLIP 05-74C	6782.0±1.16ab	10.030±0.04a	0.320±0.00d
FLIP 05-87C	5468.0±1.16e	8.843±0.02d	0.380±0.00a
FLIP 05-110C	6698.0±1.73b	10.041±0.02a	0.330±0.00cd
FLIP 05-142C	6333.3±1.73c	9.375±0.04b	0.360±0.00b
FLIP 05-150C	7082.0±1.15a	10.050±0.03a	0.290±0.00e
Local Flip1	5875.0±2.88d	9.250±0.14bc	0.360±0.00b
P-Value	0.000	0.000	0.000

Correlation coefficient analysis results in table 8 show a significantly negative coefficient (-0.518, P<0.01) between the yield, and biomass. Additionally, a significantly negative coefficient (-0.407, P<0.05) between the number of seeds plant-1, and yield, and a significant positive coefficient (0.534, P<0.01) between number of seeds plant-1 and biomass. No significant coefficients were found between protein percentage and other traits. This shows that the varieties with higher biomass gave more seeds per plant while lower yield due to their grain size smallness .

Table (8): The correlation coefficient between the studied pod traits of chickpea varieties

Variables	days to maturity	no. of seeds plant^{-1}	100 seeds weight after sowing	no. of seeds plant^{-1} (g)	yield (kg ha^{-1})	protein %	protien yiels (kg ha^{-1})	biomass (kg ha^{-1})	hay weight (kg ha^{-1})	harvest index
days to maturity	1									
no. of seeds plant^{-1}	-0.027 $^{n.s.}$	1								
100 seeds weight after sowing	0.559**	-0.119 $^{n.s.}$	1							
no. of seeds plant $^{-1}$	0.037 $^{n.s.}$	0.725**	-0.169 $^{n.s.}$	1						
yield (kg ha^{-1})	-0.168 $^{n.s.}$	-0.243 $^{n.s.}$	-0.307 $^{n.s.}$	-0.407*	1					
protein %	-0.054 $^{n.s.}$	0.174 $^{n.s.}$	-0.123 $^{n.s.}$	0.014 $^{n.s.}$	-0.127 $^{n.s.}$	1				
protien yield (kg ha^{-1})	-0.187 $^{n.s.}$	-0.167 $^{n.s.}$	-0.349 $^{n.s.}$	-0.391 $^{n.s.}$	0.917**	0.279 $^{n.s.}$	1			
biomass (kg ha^{-1})	0.113 $^{n.s.}$	0.618**	0.100 $^{n.s.}$	0.534**	-0.518**	-0.032 $^{n.s.}$	-0.514**	1		
hay weight (kg ha^{-1})	0.042 $^{n.s.}$	0.594**	0.165 $^{n.s.}$	0.500*	-0.678**	0.195 $^{n.s.}$	-0.577**	0.904**	1	
harvest index	-0.088 $^{n.s.}$	-0.550**	-0.260 $^{n.s.}$	-0.541**	0.831**	-0.005 $^{n.s.}$	0.802**	-0.818**	-0.849**	1

*significant at level alpha=0.05 ** significant at level alpha=0.01 n.s. not significant

One of the limiting chickpea production in the Kurdistan region and Iraq is referred to various diseases including fungi, viruses, and insects. The common chickpea diseases reported in this area from previous and recent studies such Ascochyta blight (Ascochyta rabiei), (Al-Maaroof and Salih, 2022; Marzani, 2003;) Fusarium wilt (Fusarium oxypsorum), Dry root rot and Black root rot (Abbas, et al., 1996). During this experiment, the only fungal disease observed on the chickpea plants was Fusarium disease (Fusarium sp.) on the Local Flip1 variety while no transference of Fusarium or any other plant diseases were noticed on the other varieties. This could show a better resistance of the newly introduced varieties (ICARDA, 2005).

CONCLUSION

In this study, it was proven that all the eight studied winter varieties used in this study are suitable to be produced in the farms located in Sulaymaniyah governorate. The variety of FLIP 97-706C was selected as most productive with the highest yield, then FLIP 05-142C for its highest protein content. Additionally, one of the advantages of the introduced winter chickpea varieties was plant height which makes it easier to harvest with the combine harvester while local spring varieties are much shorter and harvested with hands. These new varieties can be attractive for the farmers due to their excellent growth and yield trait characteristics in Sulaymaniyah Governorate. This study showed the value of the eight promising improved chickpea varieties introduced by ICARDA, with large seeds, tallness, and high yield (FLIP 97-706C, FLIP 03-87C, FLIP 05-74C, FLIP 05-87C, FLIP 05-110C, FLIP 05-142C, FLIP 05-150C) this study has selected promising verities (mainly, FLIP 97-706C) among them for largescale evaluation on the farmers' fields in different areas of Sulaymaniyah Governorate.

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صفات النمو والحاصل ونوعيته لثمانية أصناف من الحمص الشتوي في ظروف الزراعة المطرية

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حمص، Cicer arietinum ، أداء النمو ، المحصول ،زراعة المطرية

الخلاصة

هدفت هذه التجربة الى اختيار أصناف الحمص الشتوي المناسب للظروف المناخية في محافظة السليمانية. صممت هذه التجربة وفق تصميم RCBD و بثلاث مكررات و استخدمت ثمانية اصناف مختلفة FLIP 97-706C ، FLIP 03-87C، FLIP 05-74C، FLIP 05-87C، FLIP 05-110C، FLIP 05-142C، FLIP 05-150C ، Local Flip1 . اظهرت النتائج إلى أن صنف FLIP 97-706C امتلك أعلى محصول (2.1± 3531 كغم / هكتار) ، و حاصل بروتين (0.05± 390 كغم / هكتار) ، و وزن 100 بذرة (0.05± 39.0 غم) بشكل معنوي. بالإضافة إلى ذلك، أعطت الأصناف الأخرى إنتاجية عالية بشكل ملحوظ مقارنة بمتوسط إنتاجية الحمص في العالم. يمكن ان يكون لهذه الأصناف المقترحة أن تلعب دورًا مهمًا في زيادة وتحسين إنتاج وجودة الحمص، و خاصةً صنف FLIP 97-706C اذ يمكنه أن يكون من بين الأصناف الواعدة في هذه المنطقة ببذورها الكبيرة وانتاجيتها العلية وارتفاع نباتاتها .