Readers Insight
Publisher of open access books and journals
PJMLS
Print ISSN: 2707-4471. Online ISSN: 2707-448X

Research Article	Pak-Euro Journal of Medical and Life Sciences
DOI: 10.31580/pjmls.v4i4.2170	Copyright © All rights are reserved by Corresponding Author
Vol. 4 No. 4, 2021: pp. 327-336	
www.readersinsight.net/pjmls	
Submission: November 5, 2021	**Revised:** December 29, 2021 **Accepted:** December 31, 2021

EVALUATION OF DIFFERENT VARIETIES OF CHICKPEA (CICER ARIETINUM L.) UNDER AGRO-ECOLOGICAL CONDITIONS OF NAUDERO (DISTRICT LARKANA)

Aijaz Ahmed Soomro[1], Abdul Naeem Shaikh[2], Ata U Rehman[3], Shahid Riyaz[4]

[1]**Department of Agronomy,** Sindh Agriculture University, Tandojam, Pakistan

[2]**Quaid-E-Awam Agriculture Research Centre**, Larkana, Pakistan

[3]**Gulbali Institute of Agriculture,** Chalres Sturt University, Wagga Wagga, Australia

[4]**National Agriculture Research Centre (NARC),** Islamabad, Pakistan

*Corresponding Author: Dr. Aijaz Ahmed Soomro. E-mail: professoraijazahmed@gmail

Abstract

Larkana district is one of the chickpeas cultivating belts of Pakistan where farmers prefer to cultivate and harvest chickpea to supply for other regions of the country. Almost farmers of this area cultivate two local varieties Dokri Gram-89 (DG-89) and Dokri Gram-92 (DG-92). Therefore, this field study has been carried out to evaluate the six approved varieties of chickpea (Cicer arietinum L.) throughout Pakistan under agro-ecological conditions of district Larkana. The research was carried out at farmers field of the targeted area of village Kubro, Union Council Saeedo Dero, Tahsil Ratodero, District, Larkana, Sindh province of Pakistan. The results showed that the maximum plant population per treatment was recorded at 29.78 (m2) in chickpea variety KK-2, and the lowest plant population 21.62 (m-2) was recorded in variety Chattan. The highest plant height was recorded 53.33 cm in chickpea variety KK-2 and the lowest plant height at 32.66 (cm) was recorded in variety Chattan. The highest branches plant-1 was recorded at 8.20 in chickpea variety KK-2, and the lowest was 21.62 in variety Chattan. The maximum pods plant-1 were noted at 58.00 in chickpea variety KK-2, and the minimum pods plant-1 (25.33) were recorded in variety Chattan. The maximum seeds plant-1 (81.32) were recorded in chickpea variety KK-2, and the lowest seeds plant-1 at 32.54 were observed in variety Chattan. The highest seed weight plant-1 @ 13.96 g was recorded in chickpea variety KK-2, and the lowest seed weight plant-1 at 3.93 (g) was recorded in variety Chattan. The highest seed index at 28.33 g was recorded in chickpea variety KK-2, and the lowest seed index at 21.44 g was recorded in variety Chattan. The maximum biological yield at 5381.2 kg ha-1 was recorded in KK-2, and the lowest biological yield at 2522.9 kg ha-1 was noted in genotype Chattan. The highest yield of the seed at 1793.8 kg ha-1 was noted in chickpea variety KK-2, and the minimum seed yield @ 841.0 kg ha-1 was recorded in variety Chattan. The chickpea varieties were significantly affected by agro-ecological conditions of the area with the novel introduction of chickpea variety KK-2 from Karak, KPK performed best among all which could be further tested at the different field areas of Sindh province of Pakistan.

Keywords: *Chattan, Chickpea, Farmers, Gram, Kubro, Legumes*

INTRODUCTION

Chickpea (Cicer arietinum L.) is the third mainly noteworthy pulse crop taken as food in the world. It is cultivated in more than forty countries of the world. Western Asia is home of chickpea where from it spread to India and other European countries. Chickpea is a greatly healthy legume crop (1). The Desi genotypes of Gram (chickpea) in Pakistan are cultivated on about 85% and 15% is for `Kabuli' variety because of it is elevated susceptible to different stresses as compared to Desi varieties (2). It is a major nutritional legume crop of villagers and persons of the cities in the developing countries. It is a vital resource of low-cost best protein (3). It is also a great source of carbohydrates, vitamins belong to B-group, and some minerals, chiefly for the people of developing world; chickpea is a multi-functional pulse crop, which plays is significant part in the food of the small-scale farmers. Similarly, it is serving as source of protein for the peoples who cannot purchase animal meat. As chickpea is a drought tolerant crop, therefore,

growers of the Pakistan cultivate this crop at the closing stages of the main rainy season or (as dobari crop after harvest of rice crop) to utilize the residual soil moisture. This practice enhances the financial source of the growers to grow another crop by utilizing the residual soil moisture properly. Chickpea has been demanded for its nutritional grain with 25–28% protein. From the seed size of view chickpea is divided in to two main categories. These are "Desi" (smaller in size) and "Kabuli" with bold seed. As chickpea is a highly nutritive legume crop, therefore, it is not only good for human health but also improves soil health. Chickpea can survive very well on residual soil moisture; hence it offers the farmers an excellent opportunity to cultivate two crops in a same piece of land during a year to meet their food demand as well as source of income (4). The several variables of environment as well as genetics remain in interaction with chickpea during its whole period to decide its total production. Amongst the different practices of crop production and soil management (Agronomy), time of sowing is one of the very much important factors which influence the chickpea seed yield. Sowing of chickpea on exact time can be different for different varieties and also from one crop zone to another zone owing to difference in agro-ecological environment. Different sowing times affect upon both stages of the chickpea crop, these are vegetative and reproductive stages. These stages are also influenced by the different temperature ranges, photoperiod, and sunshine intensity (5). The environmental conditions in the result of various sowing times effect on both growth and developmental stages of the chickpea subject matter to the varied stages of the crop phenology, such as germination, vegetative and reproductive stages of the plant to various temperature, solar radiation, and day length. Chickpea is usually sown in between mid of Octobers to mid of November. Though, cultivation of this crop is usually late while it is cultivated after harvest of Kharif crop plants. The low temperature during seedling establishment and high temperature during grain formation can reduce the seed yield. The genotypic variation, time of sowing, crop zoning and environmental conditions can cause a major decrease in chickpea yield ranges from 30% to 60%. Sowing time can only be delayed for chickpea genotypes which are drought tolerant. Though, sowing before time and delayed can cause major decrease in per hectare yield and reduction in net profit as compared to sowing chickpea crop on time (6). However, this crop is also suitable for cultivation on sandy soils. In rice belt it has been also cultivated on irrigated lands for the last few years. This is suitable rotation of these two crops, chickpea after rice. In this way, we can utilize soil nutrients (7). Gram (chickpea) in its ability to survive well in drought, is cultivated in both tropical and subtropical environments (8). Hence local cultivation of pulses must be enhanced to face the ever-increasing demand of the pulses. One the one side, in case of developing countries, chickpea is a major source of protein. And on the other side, sowing chickpea crop improves the biological, chemical, and physical properties of the soils. It improves the soil fertility through symbiosis (biological nitrogen fixation by rhizobium bacteria from the atmosphere (9, 10). Generally, chickpea and pigeon pea studied in fallow lands where it has been recorded that these two crops are fit to raise finance of the farmers (11). Yield gap of chickpea crop between yield obtained and potential yield in Pakistan is wider, mostly due to the shortage of high yielding varieties which are appropriate for sowing in both irrigated as well as rain-fed areas of the countries. This gap could be minimized through evolving high yielding varieties to meet the needs of the farmers of these regions, currently these needs are achieved through cultivation of wheat crop in these areas. The chickpea genotypes which are more yielding and bearing bold seeds are also dire need to enhance its total production in the country as well as to get better the lifestyle of these farming communities (12). Therefore, development of new chickpea varieties with popular qualities is a constant progression. The biotic and abiotic stressful environment to the chickpea crop causes susceptibility to different genotypes as the time passes, hence, necessitates introducing tolerant genotypes with higher production characters under such stressful environment (13). In view of the significance of chickpea crop, the present study was carried out to evaluate the different chickpea (Cicer arietinum L.) varieties under agro-ecological conditions of Naudero (District Larkana, Sindh province of Pakistan).

RESEARCH METHOD STATISTICAL ANALYSIS

The experiment was laid out at farmer's field village Kubro, UC Saeedo Dero, Tahsil Ratodero under Pulses Project with the collaboration of Quaid-E-Awaam Agriculture Research Institute Naudero District Larkana during Rabi, 2018, in a three replicated randomized complete block design, all the agronomic requirements were followed as per recommendations keeping plot size of 5 m x 3 m (15m2). The details of the experiment are as below:

Experimental design = RCBD (Randomized Complete Block Design), No. of Replications = 3,

Per replication net plot size = 5 m x 3 m (15 m2), Place of work = Farmer's field @ village Kubro, Union Council (UC) Saeedo Dero, Tahsil Ratodero, District Larkana, Sindh province of Pakistan under Pulses Project funded by Australian Centre for International Agriculture Research Centre (ACIAR).

Treatment = Chickpea Varieties (V) =14, these were:

i. Chattan ii. NIAB Channa-2016 iii. Bhakkar-2011 iv. Parbat v. Noor-2013 vi. DG-89 vii. DG-92, viii. KK-1 ix. Dasht x. KK-2 xi. KK-3 xii. Thal-2006 xiii. Fakhar-e-Thal xiv. Bittle-2016

PROCEDURES FOR RECORDING OBSERVATIONS

Crop stand m^{-2}: The number of seedlings emerged in an area of 2-meter square was counted in each plot/replication and averages were worked out.

Plant height (cm): From each one of the replications five plants were selected at random. Then, these plants were tagged. The height of these randomly selected plants was measured with the help of measuring tap after final mature stage of the crop plants. Finally, average plant height was calculated and presented.

Branches $plant^{1}$: The average number of branches per plant was recorded for labeled plants.

Pods $plant^{1}$: The labeled plants were also brought under further study to note the number of pods per plant from each replication/treatment and then average of the number of pods plant was calculated to present.

Seeds $plant^{1}$: The pods studied for recording the number of pods per plant were further brought under recording the number of seeds per plant and average of this data was recorded and presented.

Seed weight $plant^{1}$(g): From all the selected five chickpea plants the seed was collected from each plot and then averages were worked out for all the replications as well as treatments.

Seed index (1000 seeds, g): The weight of one thousand chickpea seed was weighed on a "Top balance" from each replication as well as treatment.

Biological yield (kg ha^{-1}): The biological yield of each replication as well as treatment was weighed in kilograms per hectare (ha^{-1}). For this the below given formula was used:

$$\frac{\text{Biological plot}^{-1}\text{ (kg)}}{\text{Plot size (m}^2\text{)}} \times 10000$$

Seed yield in kilogram per ha^{-1}: The chickpea seed yield in kilograms per hectare (ha^{-1}) was recorded through given below formula:

$$\frac{\text{Seed yield plot}^{-1}\text{ (kg)}}{\text{Plot area (m}^2\text{)}} \times 10000$$

DATA ANALYSIS

The collected data were further brought to statistical analysis of variance using computer software statistics 8.1 (Satatix, 2006). The least significant difference (LSD) test was used to record the differences among the treatments.

PLACE OF STUDY

The experiment was conducted to evaluate different varieties of chickpea (Cicer arietinum L.) under agro-ecological conditions of village Kubro, union council Saeedo Dero of Naudero, district Larkana, Sindh province of Pakistan at Farmer's field under Pulses Project.

RESULTS

PLANT POPULATION (M^{-2})

The number of plants (m^2) of fourteen (14) chickpea varieties was investigated and the outcomes were provided in Table-I. The ANOVA exhibited that those populations of chickpea differed altogether (P<0. 05) around varieties for differentiated roots. The outcomes demonstrated that on normal bases the most elevated plant number @ 29. 78 m^{-2} recorded for chickpea variety KK-2, followed by varieties DG-92, NIAB Channa-2016, Parbat also Thal-2006 with Normal plant number for 28. 96, 28. 73, 28. 33 also 27. 80 m^{-2}, separately. The plant population was further diminished to chickpea varieties Fakhar-e-Thal (27. 10 m^{-2}), KK-3 (26. 64 m^{-2}), Noor-2013 (26. 11 m^{-2}), Dasht (25. 41 m^{-2}), DG-89 (24. 66 m^{-2}), KK-1 (23. 68 m^{-2}), Bittle-2016 (22. 457 m^{-2}) furthermore Bhakkar-2011 (22. 45 m^{-2}); same time the least plant populace for 21. 62 m^{-2} might have been recorded previously, mixed bag Chattan. The comes about indicated that varieties for different beginning responded contrastingly of the neighborhood atmosphere and as needs be those plant number might have been attained.

Table I. Plant population (m^{-2}) of different varieties of chickpea

Varieties	RI	RII	RIII	Mean
Chattan	21.21	21.65	22.00	21.62 N
NIAB Channa-2016	28.69	28.74	28.78	28.73 C
Bhakkar-2011	22.23	22.45	22.69	22.45 M
Parbat	28.12	28.34	28.55	28.33 D
Noor-2013	26.00	26.08	26.25	26.11 H
DG-89	24.35	24.67	24.96	24.66 J
DG-92	28.92	28.96	29.00	28.96 B
KK-1	23.39	23.66	24.00	23.68
Dasht	25.06	25.32	25.87	25.41 I
KK-2	29.25	30.00	30.11	29.78 A
KK-3	26.42	26.59	26.91	26.64 G
Thal-2006	27.55	27.86	28.00	27.80 E
Fakhar-e-Thal	27.00	27.08	27.22	27.10 F
Bittle-2016	22.78	22.97	23.00	22.91 L

PLANT HEIGHT (CM)

The results for plant height of 14 chickpea varieties are given in Table II. The ANOVA showed that the plant height of chickpea differed significantly (P<0.05) among varieties of diversified origin. The results indicated that on average the highest plant height of 53.33 cm, was recorded in chickpea variety KK-2, followed by varieties DG-92, NIAB Channa-2016, Parbat and Thal-2006 with average plant height of 44.33 cm, 44.33 cm, 42.33 cm, and 42.00 cm, respectively. The plant height was further decreased in chickpea varieties Fakhar-e-Thal (41.00 cm), KK-3 (40.33 cm), Noor-2013 (40.33 cm), Dasht (40.33 cm), DG-89 (37.66 cm), KK-1 (36.66 cm), Bittle-2016 (36.00 cm) and Bhakkar-2011 (33.33 cm); while the lowest plant height of 32.66 cm was recorded in variety Chattan. The results showed that varieties of different origin responded differently to the local climate and accordingly the plant height was achieved.

BRANCHES $PLANT^{-1}$

The results for branches $plant^{-1}$ of 14 chickpea varieties are given in Table III. The ANOVA demonstrated that the branches of chickpea differed significantly (P<0.05) among varieties of diversified origin. The results indicated that on average the highest branches $plant^{-1}$ of 8.20, was recorded in chickpea

variety KK-2, followed by varieties DG-92, NIAB Channa-2016, Parbat and Thal-2006 with average branches plant^{-1} of 7.97, 7.70, 7.62 and 7.52, respectively. The branches plant^{-1} was further decreased in chickpea varieties Fakhar-e-Thal (7.39), KK-3 (7.29), Noor-2013 (26.11), Dasht (25.41), DG-89 (6.94), KK-1 (6.32), Bittle-2016 (6.16) and Bhakkar-2011 (22.45); while the lowest branches plant^{-1} of 21.62 was recorded in variety Chattan. The results showed that varieties of different origin responded differently to the local climate and accordingly the branches plant^{-1} was achieved.

Table II. Plant height (cm) of different varieties of chickpea

Varieties	RI	RII	RIII	Mean
Chattan	36	32	30	32.66 C
NIAB Channa-2016	55	33	45	44.33 AB
Bhakkar-2011	32	34	34	33.33 C
Parbat	38	40	49	42.33 BC
Noor-2013	41	43	37	40.33 BC
DG-89	48	28	37	37.66 BC
DG-92	34	44	55	44.33 AB
KK-1	27	36	47	36.66 BC
Dasht	39	36	46	40.33 BC
KK-2	51	58	51	53.33 A
KK-3	45	39	37	40.33 BC
Thal-2006	48	41	37	42.00 BC
Fakhar-e-Thal	43	38	42	41.00 BC
Bittle-2016	37	36	35	36.00 BC

Table III. Branches plant^{-1} of different varieties of chickpea

Varieties	RI	RII	RIII	Mean
Chattan	5.00	5.20	5.30	5.16 L
NIAB Channa-2016	7.71	7.68	7.73	7.70 C
Bhakkar-2011	5.80	5.50	5.60	5.63 K
Parbat	7.59	7.62	7.65	7.62 CD
Noor-2013	7.12	7.16	7.18	7.15 G
DG-89	6.88	6.96	7.00	6.94 H
DG-92	7.95	7.96	8.00	7.97 B
KK-1	6.22	6.32	6.44	6.32 I
Dasht	7.03	7.06	7.07	7.05 GH
KK-2	8.1	8.2	8.3	8.20 A
KK-3	7.24	7.31	7.33	7.29 F
Thal-2006	7.49	7.52	7.55	7.52 DE
Fakhar-e-Thal	7.43	7.39	7.37	7.39 EF
Bittle-2016	6.00	6.34	6.15	6.16 J

PODS PLANT^{-1}

The results for pods plant^{-1} of 14 chickpea varieties are given in Table IV. The ANOVA demonstrated that the pods plant^{-1} of chickpea differed significantly ($P<0.05$) among varieties of diversified origin.The results indicated that on average the highest pods plant^{-1} of 58.00, was recorded in chickpea variety KK-2, followed by varieties DG-92, NIAB Channa-2016, Parbat and Thal-2006 with average pods plant^{-1} of 51.33, 43.00, 41.33 and 36.33, respectively. The pods plant^{-1} was further decreased in chickpea varieties Fakhar-e-Thal (35.33), KK-3 (35.00), Noor-2013 (32.00), Dasht (31.33), DG-89 (31.33), KK-1 (29.33), Bittle-2016 (28.66) and Bhakkar-2011 (26.33); while the lowest pods plant^{-1} of 25.33 was recorded in variety Chattan. The results showed that varieties of different origin responded differently to the local climate and accordingly the pods plant^{-1} was achieved.

Table IV. Pods plant^{-1} of different varieties of chickpea

Varieties	RI	RII	RIII	Mean
Chattan	30.00	29.00	17.00	25.33 C
NIAB Channa-2016	39.00	45.00	45.00	43.00 ABC
Bhakkar-2011	23.00	25.00	31.00	26.33 C
Parbat	24.00	28.00	72.00	41.33 ABC
Noor-2013	43.00	14.00	39.00	32.00 BC
DG-89	29.00	19.00	46.00	31.33 BC
DG-92	31.00	71.00	52.00	51.33 AB
KK-1	27.00	24.00	37.00	29.33 C
Dasht	31.00	29.00	34.00	31.33 BC
KK-2	43.00	77.00	54.00	58.00 A
KK-3	41.00	32.00	32.00	35.00 BC
Thal-2006	36.00	34.00	39.00	36.33 ABC
Fakhar-e-Thal	26.00	25.00	55.00	35.33 BC
Bittle-2016	38.00	32.00	16.00	28.66 C

SEEDS PLANT^{-1}

The seeds plant^{-1} of 14 chickpea varieties was investigated and the results are given in Table V. The ANOVA demonstrated that the seeds plant^{-1} of chickpea differed significantly ($P<0.05$) among varieties of diversified origin. The results indicated that on average the highest seeds plant^{-1} of 81.32, was recorded in chickpea variety KK-2, followed by varieties DG-92, NIAB Channa-2016, Parbat and Thal-2006 with average seeds plant^{-1} of 76.09, 67.69, 64.25 and 60.19, respectively. The seeds plant^{-1} was further decreased in chickpea varieties Fakhar-e-Thal (56.81), KK-3 (52.76), Noor-2013 (48.99), Dasht (46.70), DG-89 (43.10), KK-1 (41.06), Bittle-2016 (38.03) and Bhakkar-2011 (34.18); while the lowest seeds plant^{-1} of 32.54 was recorded in variety Chattan. The results showed that varieties of different origin responded differently to the local climate and accordingly the seeds plant^{-1} was achieved.

Table V. Seeds plant^{-1} of different varieties of chickpea

Varieties	RI	RII	RIII	Mean
Chattan	31.20	32.93	33.50	32.54 N
NIAB Channa-2016	66.44	68.32	68.32	67.69 C
Bhakkar-2011	33.80	34.09	34.65	34.18 M
Parbat	62.69	64.36	65.72	64.25 D
Noor-2013	48.66	48.62	49.69	48.99 H
DG-89	41.85	44.10	43.37	43.10 J
DG-92	74.89	78.00	85.64	76.09 B
KK-1	40.30	41.30	41.60	41.06 K
Dasht	45.50	46.80	47.80	46.70 I
KK-2	82.19	82.04	79.73	81.32 A
KK-3	51.70	52.29	54.30	52.76 G
Thal-2006	58.83	60.42	61.33	60.19 E
Fakhar-e-Thal	55.77	56.47	58.20	56.81 F
Bittle-2016	37.12	37.70	39.29	38.03 L

SEEDS WEIGHT PLANT^{-1} (g)

The seed weight plant^{-1} (g) of 14 chickpea varieties was recorded and the results are presented in Table VI. The ANOVA demonstrated that the seed weight plant^{-1} (g) of chickpea differed significantly ($P<0.05$) among varieties of diversified origin. The results indicated that on average the highest seed weight plant^{-1} of 13.96 g, was recorded in chickpea variety KK-2, followed by varieties DG-92, NIAB Channa-2016,

Parbat and Thal-2006 with average seed weight plant^{-1} of 13.00 g, 10.74 g, 10.17 g and 9.41 g, respectively. The seed weight plant^{-1} was further decreased in chickpea varieties Fakhar-e-Thal (8.69 g), KK-3 (7.86 g), Noor-2013 (6.97 g), Dasht (6.57 g), DG-89 (5.99 g), KK-1 (5.57 g), Bittle-2016 (5.03 g) and Bhakkar-2011 (4.34 g); while the lowest seed weight plant^{-1} of 3.93 g was recorded in variety Chattan. The results showed that varieties of different origin responded differently to the local climate and accordingly the seed weight plant^{-1} (g) was achieved.

Table VI. Seed weight plant^{-1} (g) of different varieties of chickpea

Varieties	RI	RII	RIII	Mean
Chattan	3.81	3.98	4.02	3.93 N
NIAB Channa-2016	10.50	11.00	10.73	10.74 C
Bhakkar-2011	4.23	4.33	4.47	4.34 M
Parbat	9.90	10.10	10.51	10.17 D
Noor-2013	6.91	6.81	7.20	6.97 H
DG-89	5.82	6.04	6.11	5.99 J
DG-92	12.36	12.79	13.87	13.00 B
KK-1	5.40	5.66	5.66	5.57 K
Dasht	6.37	6.51	6.84	6.57 I
KK-2	13.9	13.96	14.00	13.96 A
KK-3	7.60	7.79	8.20	7.86 G
Thal-2006	9.06	9.61	9.57	9.41 E
Fakhar-e-Thal	8.53	8.53	9.02	8.69 F
Bittle-2016	4.82	4.98	5.30	5.03 L

BIOLOGICAL YIELD (kg ha ^{1})

The results for biological yield in kg ha^{-1} of 14 chickpea varieties are given in Table VII. The ANOVA confirmed that the biological yield (kg ha ^{1}) of chickpea differed significantly ($P<0.05$) among varieties of diversified origin. The results indicated that on average bases the highest biological yield at 5381.2 kg ha^{-1} was noted in chickpea variety KK-2, followed by varieties DG-92, NIAB Channa-2016, Parbat and Thal-2006 with average biological yield of 5281.3 kg ha^{-1}, 4999.2 kg ha^{-1}, 4885.4 kg ha^{-1} and 4750.0 kg ha^{-1}, respectively. Moreover, the biological yield reduced in chickpea varieties Fakhar-e-Thal (4493.8 kg ha^{-1}), KK-3 (4375.0 kg ha^{-1}), Noor-2013 (4037.5 kg ha^{-1}), Dasht (3729.2 kg ha^{-1}), DG-89 (3337.5 kg ha^{-1}), KK-1 (3043.8 kg ha^{-1}), Bittle-2016 (3014.6 kg ha^{-1}) and Bhakkar-2011 (2945.8 kg ha^{-1}); even as the minimum biological yield at 2522.9 kg ha^{-1} was observed in variety Chattan. The results showed that varieties of different origin responded differently to the local climate and accordingly the biological yield (g) was achieved.

Table VII. Biological yield (kg ha ^{1}) of different varieties of chickpea

Varieties	RI	RII	RIII	Mean
Chattan	818.76	2781.24	3968.76	2522.9 C
NIAB Channa-2016	4187.49	3249.99	7560.00	4999.2 AB
Bhakkar-2011	3562.50	2012.49	3262.50	2945.8 BC
Parbat	2781.24	5000.01	6875.01	4885.4 AB
Noor-2013	4331.25	3000.00	4781.25	4037.5 ABC
DG-89	2637.51	3812.49	3562.50	3337.5 ABC
DG-92	3531.24	5906.25	6406.26	5281.3 A
KK-1	2874.99	3693.75	2562.51	3043.8 BC
Dasht	2874.99	2406.24	5906.25	3729.2 ABC
KK-2	2881.26	3450.00	9812.49	5381.2 A
KK-3	2531.25	4125.00	6468.75	4375.0 ABC
Thal-2006	3375.00	5625.00	5250.00	4750.0 AB
Fakhar-e-Thal	4250.01	3950.01	5281.26	4493.8 ABC
Bittle-2016	3099.99	3099.99	2843.76	3014.6 BC

SEED YIELD (kg ha ^{1})

The results for seed yield (kg ha ^{1}) of 14 chickpea varieties are given in Table VII. The ANOVA confirmed that the seed yield (kg ha ^{1}) of all chickpea genotypes was significantly affected at ($P<0.05$) among varieties of diversified origin. The results indicated that on average the highest seed yield of 1793.8 kg ha^{-1}, was noted in chickpea variety KK-2, followed by varieties DG-92, NIAB Channa-2016, Parbat and Thal-2006 with average seed yield of 1760.3 kg ha^{-1}, 1666.3 kg ha^{-1}, 1628.7 kg ha^{-1} and 1583.3 kg ha^{-1}, respectively. The seed yield was further decreased in chickpea varieties Fakhar-e-Thal (1498.0 kg ha^{-1}), KK-3 (1458.3 kg ha^{-1}), Noor-2013 (1346.0 kg ha^{-1}), Dasht (1243.0 kg ha^{-1}), DG-89 (1112.7 kg ha^{-1}), KK-1 (1014.3 kg ha^{-1}), Bittle-2016 (1004.8 kg ha^{-1}) and Bhakkar-2011 (982.3 kg ha^{-1}); whereas the minimum seed yield at 841.0 kg ha^{-1} was achieved in variety Chattan. The results showed that varieties of different origin responded differently to the local climate and accordingly the seed yield (g) was achieved.

Table VII. Seed yield (kg ha ^{1}) of different varieties of chickpea

Varieties	RI	RII	RIII	Mean
Chattan	273.00	927.00	1323.00	841.0 C
NIAB Channa-2016	1395.83	1083.00	2520.00	1666.3 AB
Bhakkar-2011	1188.00	671.00	1088.00	982.3 BC
Parbat	927.00	1667.00	2292.00	1628.7 AB
Noor-2013	1444.00	1000.00	1594.00	1346.0 ABC
DG-89	879.00	1271.00	1188.00	1112.7 ABC
DG-92	1177.00	1969.00	2135.00	1760.3 A
KK-1	958.00	1231.00	854.00	1014.3 BC
Dasht	958.00	802.00	1969.00	1243.0 ABC
KK-2	960.42	1150.00	3271.00	1793.8 A
KK-3	844.00	1375.00	2156.00	1458.3 ABC
Thal-2006	1125.00	1875.00	1750.00	1583.3 AB
Fakhar-e-Thal	1417.00	1317.00	1760.00	1498.0 ABC
Bittle-2016	1033.33	1033.00	948.00	1004.8 BC

CONCLUSION

Among all approved chickpea varieties of Pakistan which were evaluated in this study, commercial dwarf variety KK-2 showed overall better performance as compared to all varieties. Therefore, this innovative research study made it possible to introduce a new variety KK-2 of Khyber Pakhtunkhwa (KPK) in Sindh province of Pakistan.

Acknowledgement:

The authors are highly thankful to the Australian Centre for International Agriculture Research, Australia for providing full sponsorship to conduct such a highly important research study.

References:

1. Upadhyaya HD, Coyne CJ, Singh S, Gowda CL, Lalitha NA, Muehlbauer FJ. Identification of large-seeded high-yielding diverse kabuli accessions in newly assembled chickpea germplasm. Journal of SAT Agricultural Research. 2006;2(1):1-4.
2. Haq MA, Sadiq M, Hassan M, Shah TM, Syed H. CM 2000: A new Kabuli chickpea variety. Pak. J. of Seed Tech. 2002;1(1):45-9.
3. El-Karamany MF, Bahr AA. Effect of mineral fertilization, organic manuring and biofertilization on yield and yield components of chickpea (Cicer arietinum L.) cultivars in sandy soil. Egypt J Appl. Sci. 1999; 14(11):68-76.
4. Chavan JK, Kadam SS, Salunkhe DK, Beuchat LR. Biochemistry and technology of chickpea (Cicer arietinum L.) seeds. Critical Reviews in Food Science & Nutrition. 1987;25(2):107-58.
5. Yadav VS, Singh D, Yadav SS, Panwar JD, Singh D. Morpho-physiological basis of yield variation in chickpea under late planting conditions. Annals Agric Res. 1999;20(2):227-30.

6. Dixit GP, Srivastava AK, Singh NP. Marching towards self-sufficiency in chickpea. Curr Sci. 2019 Jan 25;116(2):239-42.
7. Mansoor M. Status of pulses in NWFP. In Proceedings of international conference on achieving sustainable pulses production in Pakistan. (Ed): A.H. chaudhry. 20-22. Nat. Agri. Res. Cent. Islamabad. Pak. Agric. Roundn. Pak. Islamabad. 2013;89-93.
8. Gaur PM, Krishnamurthy L, Kashiwagi J. Improving drought-avoidance root traits in chickpea (Cicer arietinum L.)-current status of research at ICRISAT. Plant Production Science. 2008;11(1):3-11.
9. Upadhyaya HD, Coyne CJ, Singh S, Gowda CLL, Lalitha N, Muehlbauer FJ. Identification of large-seeded high-yielding diverse kabuli accessions in newly assembled chickpea germplasm. Int. Chickpea Pigeonpea News. 2014;(13):2–5.
10. Schwenke GD, Peoples MB, Turner GL, Herridge DF. Does nitrogen fixation of commercial, dryland chickpea and faba bean crops in north-west New South Wales maintain or enhance soil nitrogen? Australian Journal of Experimental Agriculture. 1998;38(1):61-70.
11. Joshi PK, Rao PP, Gowda CL, Jones RB, Silim SN, Saxena KB, Kumar J. The world chickpea and pigeonpea economies facts, trends, and outlook. International Crops Research Institute for the Semi-Arid Tropics; 2001.
12. Khattak GS, Zamir R, Muhammad T, Rehman S. Development of high yielding, bold seeded and disease resistant kabuli chickpea (Cicer arietinum L.) mutants through induced mutations. In Proceedings of National Executive Symposium on Technologies Developed for Commercialization-Challenges and Opportunities 2003 (pp. 21-22).
13. Rao DL, Giller KE, Yeo AR, Flowers TJ. The effects of salinity and sodicity upon nodulation and nitrogen fixation in chickpea (Cicer arietinum). Annals of Botany. 2002 May 1;89(5):563-70.
14. M. Naveed, M. Shafiq, M. Nadeem, M. U. Haq and M. A. Zahid. "NOOR-2013" A bold seeded and high yielding chickpea kabuli variety developed indigenously. The Journal of Animal & Plant Sciences, 30(4): 2020, Page: 885-894.
15. Siddique KH, Brinsmead RB, Knight R, Knights EJ, Paull JG, Rose IA. Adaptation of chickpea (Cicer arietinum L.) and faba bean (Vicia faba L.) to Australia. In Linking research and marketing opportunities for pulses in the 21st century 2000 (pp. 289-303). Springer, Dordrecht.