Research Journal of Chemical Sciences _____ ISSN 2231-606X
Vol. **3(4),** 25-28, April **(2013)** *Res. J. Chem. Sci.*

Chemical Composition of Kabuli Chickpea Collections under Water Stress and Non-stress

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Available online at: www.isca.in
Received 16th January 2013, revised 23rd February 2013, accepted 28th March 2013

Abstract

Estimations of the metabolic products and accumulated ions were made to work out the chemical composition of grain protein, starch, soluble sugars and mineral contents in fourteen Kabuli chickpea samples under water stress to non-stress conditions. Results indicated that a higher amount of grain protein and soluble sugars were found under moisture stress however starch content decreased. Chemical analysis for mineral composition of Kabuli chickpea showed that accumulation of K and Mg increases and total P, Zn, Ca and Fe decreases in the samples of moisture stress environment.

Keywords: chemical composition, mineral contents, chickpea.

Introduction

Chemical composition and nutrient value of chickpea makes it an important food supplement for mankind. In India although it is grown under varied environmental conditions of extreme moisture stress to non-stress conditions, it is grown mostly as a post-rainy season rainfed crop. Water stressed environmental condition is one of the most limiting factor in the determination of composition of organic compounds and mineral elements of chickpea. Concentration of mineral element in plants reduces significantly under drought as a consequence of moisture stress in drought environment. Earlier studies on quantitative estimation of mineral elements in chickpea seeds under different environments were done without considering water stress and non stress. Only some recent studies defined the effects of water stress on chemical composition of chickpea. Studies on barley showed that water stress affect proline content and yield[1]. Likewise effect of moisture stress and non stress on chickpea with reference to organic compounds viz. protein, carbohydrate, fat etc. have been studied[2-3] but there is little information available concerning effect of moisture stress and non stress on mineral composition.

Material and Methods

Fourteen varieties of Kabuli chickpea were selected which are commonly in use for this study. The experimental material grown under two environmental conditions viz. moisture stress and non stress with two replications. Two sets of each variety were grown, one in stress and other non stress. At maturity 10 plants were selected and then the grain obtained from the selected plants was bulked for chemical analyses.

Sodium and potassium contents were determined by flamephotometry. Acid digest prepared by oxidizing each sample with a nitric/perchloric acid (2:1) mixture. Aliquots used to determine Na and K using flamephotometry. Phosphors (P) content was determined by spectrophotometric method. Ca, Mg, Fe, and Zn minerals determined by atomic absorption spectrophotometry (AOAC. 1980, AOAC.1990). Nitrogen (N) content estimated by Kjeldal procedure (AOAC 1985) and protein content determined by Lowry method (1951)[4] using the Folin- Ciocaltea phenol reagent. Carbohydrates are one of the most important components in chickpea. The carbohydrate component estimated by Enthrone method. Sugars react with the enthrone reagent under acidic conditions to yield a blue-green color. There is a linear relationship between the absorbance and the amount of sugar that was present in the original sample. This method determines both reducing and non-reducing sugars because of the presence of the strongly oxidizing sulfuric acid.

Results and Discussion

Concentrations of grain protein, starch and soluble sugars of 14 Kabuli chickpea samples were analyzed (table 1) to work out the chemical composition under moisture stress to non-stress conditions. Results of chemical analysis indicated that a higher amount of grain protein[3] and soluble sugars were found under moisture stress however starch content was decreased[5-6]. Mean value of protein concentration increased from 21.09% to 22.20 %. Maximum increase of 1.67% was seen in sample of C-711. Chemical analysis showed that mean value of starch concentration decreased from 44.5.0% to 43.1%. Highest decrease of 2.2% reported in starch content of samples of C-711. Soluble sugar content was also varied from 3.81% to 5.69%.There was an increase in mean value of soluble sugars content. Maximum increase of 1.38% in soluble sugars content was seen in C-727 which showed 4.59% soluble sugars content in moisture stressed sample while 4.31% in non stressed sample of Kabuli chickpea[7].

Table-1
Chemical composition of Kabuli chickpea grain protein, starch and soluble sugars under moisture stress and non-stress.(g/100g)

Collection	Protein %		Starch %		Soluble sugars %	
	Non-stressed	Moisture stressed	Non- stressed	Moisture stressed	Non- stressed	Moisture stressed
JGK-3	21.27	22.85	45.1	43.5	4.29	5.37
C-701	20.71	21.53	43.5	42.7	4.15	4.85
C-703	21.30	21.68	43.9	43.1	3.81	4.64
C-704	21.57	22.65	44.7	43.3	4.29	4.52
C-711	20.51	22.18	45.2	44.0	4.33	4.78
C-714	21.11	22.69	43.7	43.3	4.19	4.85
C-716	21.96	23.47	45.1	43.7	4.14	5.09
C-723	20.72	22.33	43.3	41.9	4.17	4.93
C-725	21.58	22.06	45.8	42.9	3.91	4.35
C-729	20.16	21.59	44.7	43.4	4.21	5.13
C-720	21.24	22.21	44.3	43.6	4.15	4.75
C-727	21.29	21.35	42.9	41.5	4.31	5.69
C-731	20.27	21.93	45.3	43.1	4.41	5.37
C-707	21.57	22.35	44.8	43.5	4.57	5.13
Mean	21.09	22.20	44.5	43.1	4.21	4.96

Concentrations of total accumulated ions of K, Mg, P, Fe, Zn and Ca of Kabuli chickpea in response to moisture stress and non-stress are given in table 2. Chemical analysis for mineral composition of Kabuli chickpea showed increase in the accumulated ions of K and Mg. Increase in K content varied from 28 mg/100g (C-723) to 114 mg/100g (C-714). Results of analysis show that mean Mg content increased from 139 mg/100g to 148 mg/100g. Increase in Mg content was 2 mg/100g (C-731) to 16 mg/100g (C-701) in the samples subjected to moisture stress[7-8]. However grain samples collected from moisture stressed plants were poorer in Phosphorous, Zink, Calcium and Iron. Total P, Zn, Ca and Fe contents were decreased in the samples of moisture stress environment. Similar results were reported earlier[8] for P, Zn, Ca and Fe contents in Kabuli chickpea. Maximum reduction of 44.0 mg/100g in P content was recorded in sample of C-727 in comparison to mean reduction of 19.4 mg/100g[10].

Calcium content also showed mean reduction of 13 mg/100g with maximum reduction of 25 mg/100g in C-704 sample. Reduction in concentrations of total accumulated ions of Zn and Fe also reported in all the samples. Maximum reduction in Zn content was of 0.5mg/100g in sample of C-723.While maximum reduction in Fe content was 0.7mg/100g (C-716). Above study suggested that decreasing water availability under drought generally results in higher concentration of protein and soluble sugars in Kabuli chickpea but reduced total mineral elements uptake and frequently causes reduced concentrations of mineral elements in crop plants[11-12].

Conclusion

In this study a higher amount of grain protein and soluble sugars were found under water stress samples Kabuli chickpea however starch content decreased. Chemical analysis for mineral composition of Kabuli chickpea showed that accumulation of K and Mg increases and total P, Zn, Ca and Fe decreases in the samples of moisture stress environment.

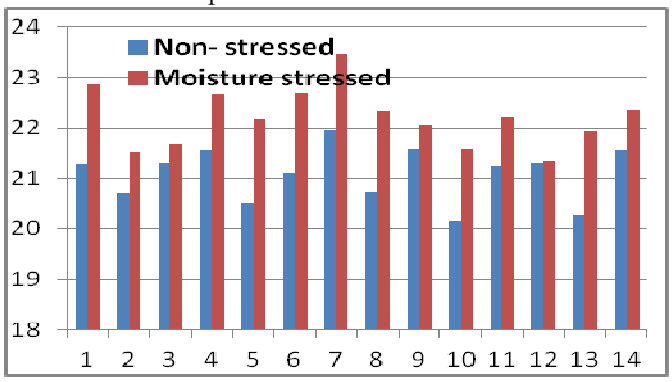

Figure-1
Estimates of grain protein content (g/100g)

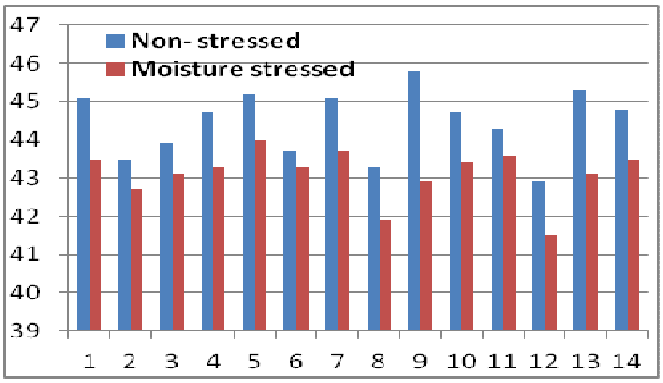

Figure-2
Estimates of starch concentration (g/100g)

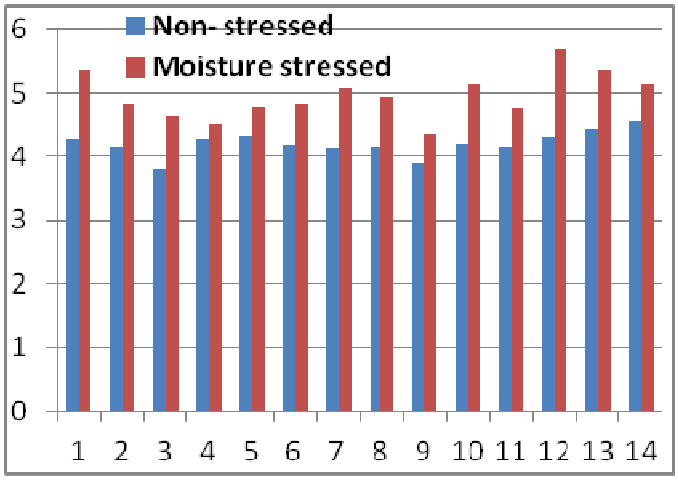

Figure-3
Estimates of Soluble sugars (g/100g)

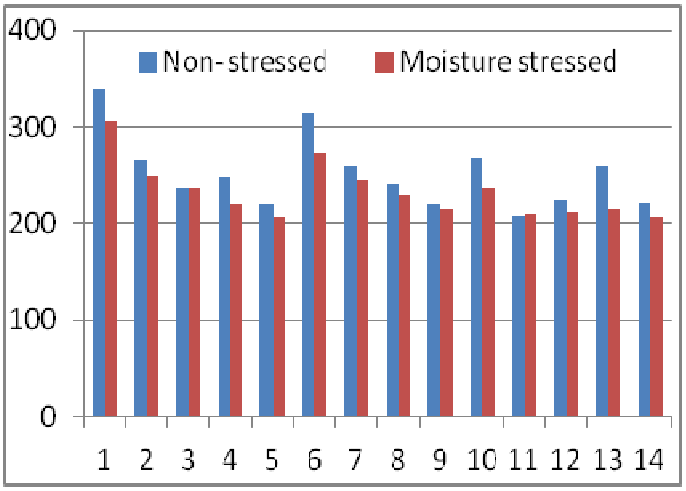

Figure-6
Phosphorous content (mg/100mg)

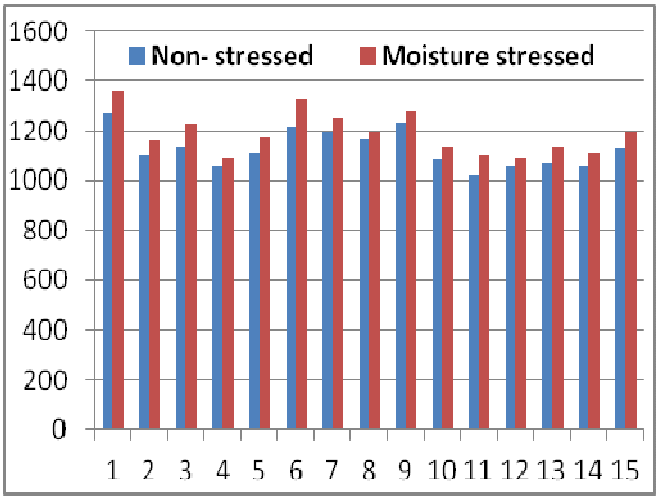

Figure-4
Potassium content (mg/100g)

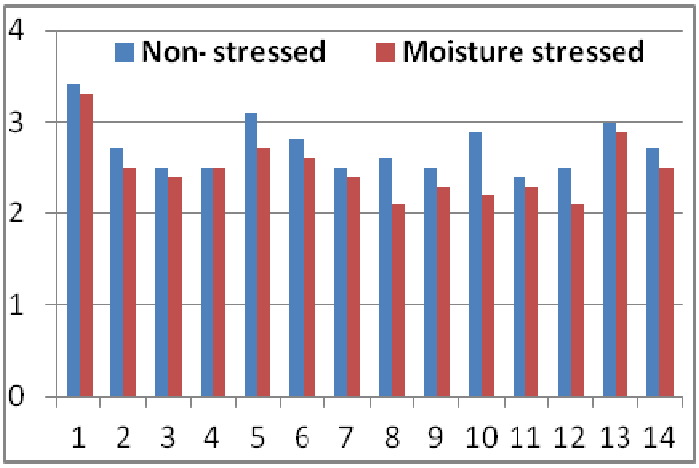

Figure-7
Zink content (mg/100mg)

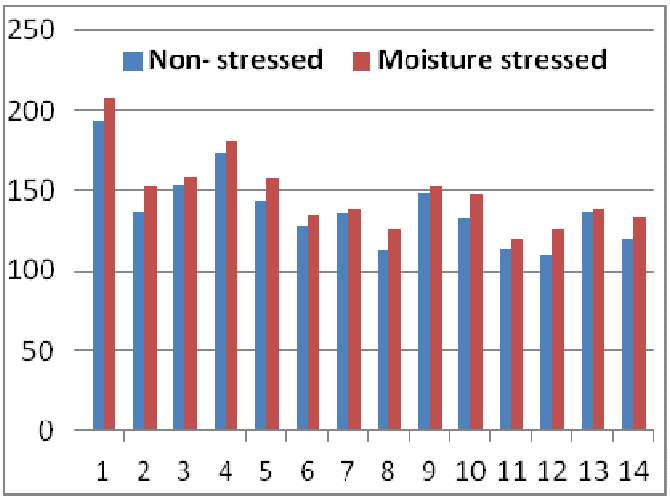

Figure-5
Magnesum content (mg/100g)

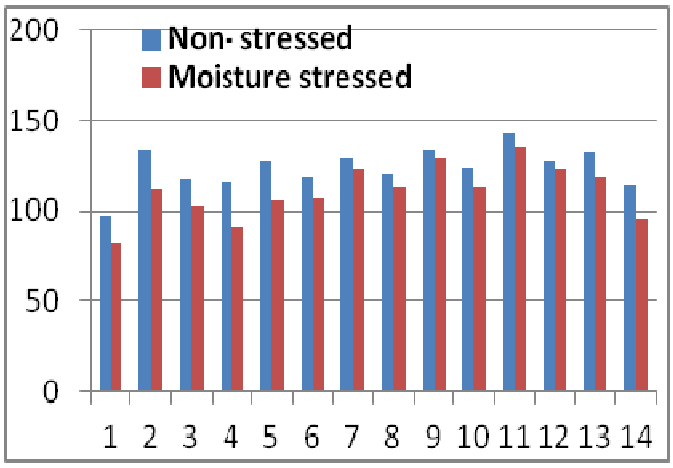

Figure-8
Calcium content (mg/100mg)

Figure 1-8 Showing changes in Kabuli chickpea chemical composition under water stress.

Table-2
Mineral composition of Kabuli chickpea grain under moisture stress and non-stress

Collection	Potassium (K) mg/100g		Magnesium (Mg) mg/100g		Phosphorous (P) mg/100g		Zink (Zn) mg/100g		Calcium (Ca) mg/100 g		Iron (Fe) mg/100g	
	Non-stressed	Moisture stressed	Non-stressed	Moisture stressed	Non-stressed	Moisture stressed	Non-stressed	Moisture stressed	Non-stressed	Moisture stressed	Non-stressed	Moisture stressed
JGK-3	1272	1363	194	208	339	307	3.4	3.3	97	83	4.3	3.9
C-701	1106	1158	137	153	265	248	2.7	2.5	134	112	3.8	3.2
C-703	1137	1227	154	158	236	235	2.5	2.4	118	103	3.5	3.2
C-704	1063	1095	173	181	247	219	2.5	2.5	116	91	3.3	3.1
C-711	1109	1173	143	157	219	205	3.1	2.7	127	106	3.7	3.2
C-714	1215	1329	128	135	315	271	2.8	2.6	119	107	3.4	3.0
C-716	1194	1254	136	139	259	243	2.5	2.4	129	123	4.6	3.9
C-723	1165	1193	113	126	241	229	2.6	2.1	121	113	3.5	3.1
C-725	1234	1274	149	153	219	214	2.5	2.3	134	129	3.8	3.4
C-729	1087	1135	133	148	267	235	2.9	2.2	124	113	3.3	3.0
C-720	1021	1107	114	120	208	209	2.4	2.3	143	136	3.1	2.9
C-727	1062	1093	110	126	224	211	2.5	2.1	127	123	3.4	3.1
C-731	1075	1135	137	139	258	214	3.0	2.9	133	119	3.2	3.1
C-707	1063	1109	120	134	221	205	2.7	2.5	114	96	3.4	3.2
Mean	1128	1189	139	148	251	232	2.7	2.4	124	111	3.6	3.2

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